



California Regional Water Quality Control Board
Central Valley Region
ACL Complaint No. R5-2005-0501

In the Matter
of
Hilmar Cheese Company, Inc.
Hilmar Whey Protein, Inc.

Expert Report and Prepared Direct Testimony of

Mark Berkman, PhD
and
David Sunding, PhD

On Behalf of Hilmar Cheese Company, Inc. and Hilmar Whey Protein, Inc.

Privileged and Confidential

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QUALIFICATIONS

Mark Berkman is a vice president of CRA International (CRAI), an economics and management consulting firm. He has over 20 years of experience regarding environmental, health, and safety policy. Dr. Berkman earned his PhD in public policy analysis and applied economics from the University of Pennsylvania. His resume is attached in Appendix A.

David Sunding is a professor of agricultural and resource economics at the University of California, Berkeley and a senior consultant at CRAI. He is also Director of the UC Berkeley Center for Water Resources. Professor Sunding's research is primarily focused on water policy and pollution issues and he has frequently published on these topics. Dr. Sunding earned his PhD in agricultural and resource economics at the University of California, Berkeley. His resume is attached in Appendix A.

I. PURPOSE AND SUMMARY

The California Regional Water Quality Control Board, Central Valley Region, (hereafter RWB) Staff recently found that the Hilmar Cheese Company and the Hilmar Whey Protein Company (hereafter Hilmar) exceeded the EC discharge limit allowed in Hilmar's 1997 discharge permit, and proposed a \$4 million penalty for the Board's consideration.¹ We have been retained on behalf of Hilmar to address whether the proposed penalty can be justified on economic grounds.

To make this determination we have considered the following questions:

- Did the RWB Staff adequately consider the State Water Resource Control Board (SWRCB) policy guidance for determining the proposed administrative civil liability?

¹ WDR Order No. 97-206 established an EC wastewater limit of 900 μ mhos/cm. Administrative Liability Complaint, No. R5-2005-0501 proposes the penalty. EC refers to electric conductivity of water, an indicator of saltiness.

- Did Hilmar benefit from noncompliance?
- Is the proposed penalty in the public interest?

As discussed in detail below, we have concluded that the penalty can not be justified on economic grounds. More specifically, we found that:

- **The RWB Staff did not apply SWCRB policy guidance in a rigorous and coherent manner**

The RWB Staff did not provide the basis for its recommended \$4 million penalty. Although the RWB Staff's report acknowledged most of the basic factors identified in the SWCRB policy guidance, the RWB Staff did not follow the stepwise procedure suggested by the policy guidance. Consequently, the RWB Staff does not explain how the \$4 million was calculated. The RWB Staff failed to quantify a key factor identified in the guidance—the extent and severity of damages to beneficial water use resulting from Hilmar's EC limit exceedances. This omission speaks volumes about the lack of clear environmental damage associated with Hilmar's actions.

- **Hilmar did not gain any economic benefit from noncompliance.**

In fact, Hilmar invested over \$41 million in compliance technology and expended over \$44 million in operating costs to treat its wastewater since 1997. Moreover, Hilmar's actions did not improve its competitive position. The various methods used by the RWB Staff to estimate benefits for purposes of setting a penalty suffer from fatal defects. The RWB Staff relies on inappropriate compliance cost benchmarks and understates Hilmar's actual compliance costs by arbitrarily allocating operating costs and excluding capital costs. In addition, the application of the U.S. EPA BEN model is inconsistent with US EPA guidance regarding its use for the calculation of civil penalties.

- **The RWB Staff's proposed penalty is not in the public interest.**

The RWB Staff's attempt to impose on Hilmar an unprecedented civil liability of \$4 million demonstrates a serious loss of perspective since the water quality impacts associated with Hilmar's operations have not been well demonstrated and are likely to be

very small. Available evidence suggests that the proposed penalty greatly exceeds any current or foreseeable environmental damages resulting from Hilmar's exceedances. In addition, imposition of the proposed penalty will discourage cooperation with RWB Staff, and stifle efforts to develop new technologies and approaches to improve wastewater quality. Hilmar has attempted to comply using novel technology – encouraged by the Regional Board. Imposing a penalty of this magnitude on a cooperative firm willing to comply by making substantial investments in advanced technology will signal other firms that such efforts are not rewarded and may in fact be punished.

The limited environmental damages likely to be associated with Hilmar exceedances and the high cost of compliance raise concerns regarding the economic efficiency of the EC standard. It is important to recognize that the current EC limit was not based on a cost-benefit analysis. Compliance with an inefficient standard lowers social welfare, and residents of the Central Valley have much at stake in the debate over appropriate water quality standards. An optimal standard balances several public policy objectives, including protection of actual and future beneficial uses, creation of jobs and economic activity, and harnessing technological innovations to lower the cost of compliance. With respect to compliance costs, Hilmar already bears a much larger burden than its competitors. Reductions in Hilmar's operations could result in a substantial loss to the regional economy in jobs and tax revenues. Further losses would result should Hilmar and other food processors be deterred from further investments in the San Joaquin Valley.

II. BACKGROUND

In late 1997, the Regional Water Quality Control Board, based on the guidelines published in the *Water Quality Control Plan for the Sacramento and San Joaquin River Basins, 3rd Edition*, issued Waste Discharge Requirements ("WDR") Order No. 97-206 for Hilmar. The order provided that as of March 15, 1999, wastewater from the Hilmar processing plant should not exceed an electrical conductivity value of 900 $\mu\text{mhos/cm}$. The WDR directed Hilmar to measure the electrical conductivity of the wastewater and

complete self-monitoring reports (SMRs) in order to assess compliance with the effluent limit.

In December 2004, the RWB issued Cleanup and Abatement Order No. R5-2004-0722. This mandate requires Hilmar to address the impacts of its discharge on groundwater and to continue to abate offensive odors.

In late January 2005, the RWB Staff filed an Administrative Civil Liability Complaint (ACL) proposing that Hilmar pay an administrative civil liability of \$4 million. The RWB Staff based its findings on the SMRs prepared from January 27, 2002 through November 30, 2004, which provided evidence that Hilmar had exceeded the EC limit of WDR 97-206 for 1,039 days (i.e., every day from January 27, 2002 through November 30, 2004). During this time, 821 million gallons of partially-treated or untreated wastewater was discharged to the primary fields. In addition, sampling of groundwater from January 2002 through February 2004 demonstrated EC values of 1,500 to 2,700 $\mu\text{mhos/cm}$.

Two and a half months later, on April 8, 2005, the RWB Staff released a Staff Report intended to provide a basis for the penalty proposed by the ACL complaint. The report provides additional background information and a discussion of the benefits calculations using several methods and assumptions.

The report does not, however, directly explain how the RWB Staff arrived at the \$4 million penalty figure. The RWB Staff calculates that Hilmar economically benefited from avoiding and/or delaying compliance with WDR 97-206 using two methods resulting in several benefit estimates. First the RWB Staff relies on a comparison of average treatment costs reported by municipal wastewater treatment facilities to a fraction of Hilmar's wastewater treatment operating costs. Since Hilmar's costs as reported by the RWB Staff are below the facility average, the RWB Staff defines the difference as a benefit to Hilmar. This method results in an estimate of \$3.54 million. The RWB Staff notes that this figure could be higher or lower depending on the

assumptions applied.² The second method relies on the U.S. EPA BEN model. This model calculated benefits based on estimated savings from compliance avoidance or delay. The RWB Staff applies this model by assuming that Hilmar could have complied as early as 2001 by installing an RO system suggested by a consulting engineering firm or by installing elements of its V-SEP treatment system.³ This method results in benefits of between \$0.8 and \$3.2 million.

III. THE RWB STAFF DID NOT APPLY STATE BOARD ENFORCEMENT GUIDELINES IN A RIGOROUS AND COHERENT MANNER

As described above, the RWB Staff in its draft report does not explain the basis for its recommended \$4 million penalty. The State Water Resources Control Board Water Quality Enforcement Policy describes a “stepwise approach” incorporating the features that must be considered in assessing an ACL penalty.⁴ This stepwise approach is described in Table 1. The method incorporated in these steps calls first for the quantification in dollar terms of the liability resulting from the discharge event with special attention to the beneficial use impairment followed by a series of adjustments (both up and down) accounting for various factors including the dischargers conduct, severity of the threat to human health or the environment, economic benefit, RWB Staff costs, and ability to pay. The RWB Staff report does not follow this stepwise process. It neither quantifies the liability nor makes adjustments for the various factors identified in the policy. The only step the RWB Staff quantifies is economic benefit, but no specific dollar adjustments for other factors is made to the benefits estimates or suggested for consideration. Consequently, the Board is given no guidance by the RWB Staff on how

² The RWB Staff further notes that if the fraction of Hilmar’s wastewater treatment costs allocated to primary lands is increased, then the “savings” or benefit would be reduced. The Staff also notes that if Hilmar’s costs to discharge to secondary lands on a per gallon basis are applied to the discharge to secondary lands then the “savings” or the benefit could be as high as \$22.2 million.

³ (1) "Staff Report, Administrative Civil Liability, Hilmar Cheese Company, Cheese Processing Plant, Merced County," Draft Version, April 8, 2005.

(2) "Economic Benefit, Analysis for ACLC Staff Report, Hilmar Cheese Company, Merced County," from Alexis Phillips-Dowell, WRCE, April 26, 2005.

⁴ "Water Quality Enforcement Policy," State Water Resources Control Board / California Environmental Protection Agency, February 19, 2002, pp 34-41.

to fully evaluate the recommended penalty as envisioned by the Enforcement Policy document.

Table 1. Procedure to set ACL amounts (Table VII-1 in Water Quality Enforcement Policy).

Step	Procedure
A. Initial Liability	Set an initial liability based on the extent and severity of the violation and the sensitivity of the receiving water. An initial liability should also be calculated for non-discharge violations.
B. Beneficial Use Liability	If possible, estimate the dollar value of any impacts of the violation on beneficial uses of the affected waters.
C. Base Amount	The Base Amount is a single amount that is a result of combining the figures derived from the first 2 steps. For many ACLs, the base amount will simply be the initial liability from step A. because the calculation of the beneficial use liability may not be appropriate. The base amount reflects the extent and severity of the violation and its impact on beneficial uses.
D. Adjustment for discharger's conduct	Determine factors to adjust the Base Amount with respect to the conduct of the discharger's history of violations and other considerations. Apply these factors to the Base Amount from step C.
E. Adjustment for other factors	Determine whether any other factors should be taken into consideration when setting the ACL amount. If appropriate, adjust the figure from Step D to include these factors.
F. Economic Benefit	Estimate the economic benefit to the discharger. Economic benefit is any savings or monetary gain derived from the acts that constitute the violation. Add the economic benefit to the amount in step E.
G. Staff Costs	Estimate the SWRCB and RWQCB Staff costs resulting from the violation. Add this cost to the figure determined from steps A through F.
H. Adjustment for ability to pay	If appropriate, increase or reduce the figure from Steps A through G with respect to the discharger's ability to pay and ability to continue in business.
I. Check against statutory limits	Check the figure from steps A through H against the statutory maximum and minimum limits.

Source: "Water Quality Enforcement Policy," State Water Resources Control Board / California Environmental Protection Agency, February 19, 2002, p.36.

The staff's failure to quantify the initial and beneficial water use liability associated with Hilmar's exceedance of the EC limit suggests that there is no hard evidence that environmental or human health damages have occurred or are likely to occur.

IV. HILMAR DID NOT GAIN AN ECONOMIC BENEFIT FROM NONCOMPLIANCE OR DELAY

Economic benefit is defined by the State Water Resources Control Board as “any savings or monetary gain derived from the acts that constitute the violation.”⁵ The principal “acts” are the avoidance of or delay in compliance. The Board also observes that, “in cases where the violation occurred through no fault of the discharger and it was demonstrated that the discharger exercised due care then there may be no economic benefit.”⁶ Consequently, it is important to review Hilmar’s efforts to comply with the EC limit.

A. Hilmar Made a Series of Investments in Compliance Technology

In late 1996, Hilmar performed tests of a proprietary semi-permeable membrane system called Vibratory Shear Enhanced Processing (V-SEP).⁷ This system collected the retentate from the membranes and concentrated it to cattle feed. The system was going to be implemented in two phases. Phase I involved two 350,000-gallon flow equalization tanks and seven V-SEP membrane filtration units and would be operable in March 1998. Phase II would double the capacity and be functional in March 1999.⁸ The capital costs during Phase I totaled over \$3.4 million. However, the V-SEP system with nanofiltration technology proved unreliable. Accordingly, V-SEP was modified to incorporate a two-stage system: an ultrafiltration stage followed by a reverse osmosis (RO) stage. A modified Phase 2 of the project began in the third quarter of 1999. During that time, Hilmar converted the seven nanofiltration membranes to the ultrafiltration models and added six V-SEP units equipped with reverse osmosis membranes. The capital costs expended for this phase totaled \$3,056,573.⁹

In April 2000, Brown and Caldwell submitted a Report of Waste Discharge on behalf of Hilmar. This report indicated Hilmar intended to increase wastewater to a projected 1.25

⁵ "Water Quality Enforcement Policy," State Water Resources Control Board / California Environmental Protection Agency, February 19, 2002, p. 39.

⁶ Ibid.

⁷ "Timeline of Treatment V5.xls," undated, reproduced in Table 2 of this report.

⁸ "California Regional Water Quality Control Board, Central Valley Region: Order Number 97-206, Waste Discharge Requirements for Hilmar Cheese Company, Inc., Hilmar Whey, Inc., Hilmar Cheese Company Properties Partnership, Alvin A. and Devona Wickstrom, Kathy and Delton Nyman d.b.a. Delton Nyman's Farm, and Jose G. and Marie C. Silveira, Merced County," September 19, 1997, p.4.

⁹ "Timeline of Treatment V5.xls," undated.

mgd following expansion.¹⁰ This plan specified that 65% of the waste stream would pass through UF and RO. This is the waste stream generated from the cheese pit. The lactose pit water would bypass the UF and RO treatment but would be combined with the RO permeate. Hilmar expected the combined waste stream would meet EC requirements.¹¹ In June, 2000, the RWB Staff expressed concerns regarding organic loading and threatened to draft WDRs with loading rate limits.¹² In response, Hilmar modified their discharge plan to treat 100% of the wastewater.¹³ In October 2000, Hilmar initiated Phase 3, which resulted in the construction of a large, primary crossflow reverse osmosis unit. Additionally, they exchanged the reverse osmosis membranes with ultrafiltration membranes in six V-SEP units. The updates to the treatment system cost \$1,837,662. At this point, there were 13 V-SEP units, all with ultrafiltration membranes.

In February, 2001, Hilmar submitted another RWD indicating an increase in flow to 1.5 mgd.¹⁴ In July 2001, Hilmar installed a second large, primary crossflow reverse osmosis unit and a smaller, secondary crossflow unit. An additional seven V-SEP units with ultrafiltration membranes were added. The total capital cost of these improvements was \$5,265,998. An evaporator was installed soon after to further concentrate the retentate for secondary reverse osmosis treatment prior to shipment, and it cost \$3,674,491. Despite all of these significant investments in V-SEP, the lactose pit water continued to cause membrane fouling (bacteria interfering with membrane functionality) and scaling (mineral precipitate, including, calcium carbonate, magnesium carbonate, calcium sulfate, silica, calcium phosphate, and magnesium phosphate).¹⁵

¹⁰ "Report of Waste Discharge for Hilmar Cheese Company, Hilmar, California, April 2000," prepared by Brown and Caldwell, pp.3-3 to 3-4.

¹¹ "Report of Waste Discharge for Hilmar Cheese Company, Hilmar, California, April 2000," prepared by Brown and Caldwell, p.3-5 to 3-6.

¹² (1) Letter from Douglas Patteson to Tedd Struckmeyer regarding Report of Waste Discharge, Hilmar Cheese Company, Merced County, June 2, 2000.

(2) Letter from Bert Van Voris to John Jeter regarding Report of Waste Discharge supplementing June 2, 2000, letter, August 2, 2000.

¹³ Personal communication with Tedd Struckmeyer. See also "Draft: Hilmar Cheese Company, Meeting with Regional Board," August 22, 2000.

¹⁴ "Report of Waste Discharge for Hilmar Cheese Company, Hilmar, California, February 2001," prepared by Brown and Caldwell.

¹⁵ "NutraLAC Weekly Meeting Minutes, Date: 12/18/01, Attendees: Don, Dave, Alex, Patty, Paul, Tedd, Donna."

In February 2002, in response to the shortcomings of V-SEP, Hilmar investigated disposal options to the city of Turlock. In April 2002, Hilmar designed a pipeline and began obtaining property easements.¹⁶ At the same time, Hilmar commissioned a study to evaluate the development of a complete wastewater treatment facility onsite.¹⁷ Hilmar made draft agreements with Turlock Regional Water Quality Control Facility to process 50-60% of Hilmar's excess wastewater by June 2003.¹⁸ Disposal at Turlock and a complete onsite waste treatment plant would both require on-site physico-chemical dissolved air flotation (PCDAF) treatment to remove suspended solids. Accordingly, Hilmar immediately pursued PCDAF technology. In October, 2002, Hilmar installed the first PCDAF to replace failed V-SEP units.

In February 2003, Hilmar received notice that Turlock was no longer viable.¹⁹ In March 2003, eight sand filters were installed to process the PCDAF outflow before it reached the reverse osmosis units. A few months later, a second PCDAF unit was added to the treatment system. The two PCDAF units and the sand filters cost Hilmar approximately \$1.85 million in capital expenditures.

During this same time, Hilmar engineers visited an aerobic digesting facility at a cheese plant in Lemoore, but found the aerobic digesters produced odors and were energy inefficient. At this time, high rate anaerobic digesters were used in other industries, but no U.S. dairy/cheese plants were using them on the scale necessary at Hilmar. In June 2003, Hilmar engineers toured a Holland lactic acid plant utilizing anaerobic technology. Hilmar entered into a \$2 million contract with Biothane to install Expanded Granular Sludge Bed (EGSB) anaerobic digesters.²⁰

¹⁶ "Timeline of Treatment V5.xls," undated.

¹⁷ "Review of Wastewater Treatment Systems at Hilmar Cheese Company," John Campbell, Launch Technology Limited, May 2002.

¹⁸ Letter from Tedd Struckmeyer, Vice President Engineering and Business Development at Hilmar, to Stephen Klein, California Regional Water Quality Control Board, September 5, 2002.

¹⁹ Letter from Cliff Martin, Municipal Services Director for the City of Turlock, to Warren Climo, Hilmar Cheese Corporation, February 24, 2003.

²⁰ Personal communication with Tedd Struckmeyer, Hilmar Cheese Company.

In August 2003, a second large, secondary crossflow reverse osmosis unit was installed to increase concentrate capacity. At this point the treatment system consisted of two PCDAF, eight sand filters, two large, primary reverse osmosis units, and one large and one small secondary reverse osmosis units. In December 2003, Hilmar began constructing the expanded granular sludge bed for anaerobic transformation of organic loads to methane gas. This addition cost \$4,077,662. Approximately four months later, Hilmar began construction of sequenced batch reactors to remove residual BOD (biological oxygen demand, an indicator of organics) and nitrogen, at a capital cost of \$3,605,574. In 2005, Hilmar installed additional primary and secondary RO units, additional UF units, an evaporator and other ancillary equipment at a cost of about \$13.4 million. These investments are summarized in Table 2.

Table 2. Hilmar Cheese Company, Wastewater Treatment Activities and Expenditures, 1996-2005

Month / Year	Activity	Capital Expenditure	Annual Operational Expenditure
Oct 1996 to Apr 1997	Research and trials of a nanofiltration (NF) membrane version of VSep equipment supplied by New Logic Corporation.		
Apr 1997	Phase 1 of VSep system completed: installation of seven units containing NF membranes.	\$3,458,616	
Jan 1998	HCC submitted a Revised Wastewater Reclamation Management Plan to the Regional Board (RWQCB).		
Jan-Dec 1998			\$946,701
Feb 1999	HCC submitted a Monitoring Well Network Program Groundwater Analysis Report to the Regional Board for monitoring wells MW-11 to MW-20.		
Third Quarter 1999	Phase 2 of VSep System completed: installation of six additional VSep units with reverse osmosis (RO) membranes. Existing seven VSep units converted from NF membranes to ultrafiltration (UF) membranes.	\$3,056,573	
26 Nov 1999	Gymperle property leased to increase waste discharge area.		
Jan-Dec 1999			\$1,274,718
28 Apr 2000	HCC submitted 2000 Report of Waste Discharge (RWD) to RWQCB for 1.25 mgd discharge.		
Oct 2000	Phase 3 of VSep System completed: installation of large primary crossflow reverse osmosis unit (RO#1) and conversion of six VSep units with RO membranes to UF membranes. Processing system included 13 VSep units with UF membranes, followed by large crossflow RO unit.	\$1,837,662	
Jan-Dec 2000			\$1,587,562
Feb 2001	HCC submitted 2001 RWD to RWQCB.		
Jul 2001	Phase 4 of VSep System completed: installation of second large primary crossflow RO unit (RO#2) and a smaller secondary crossflow reverse osmosis unit (RO#3). Addition of seven VSep units with UF membranes. System included 20 VSep units with UF membranes, two large primary crossflow RO units, and one small secondary crossflow RO unit.	\$5,265,998	
Oct 2001	Concentrate Evaporator purchased.	\$3,674,491	
Jan-Dec 2001			\$4,430,229
4 Feb 2002	Gymperle property purchased.		
April 2002	Pipeline design and property easements initiated for pipeline to Turlock Regional Water Quality Facility.		
May 2002	Draft agreement executed with Turlock Regional Water Quality Control Facility to process 50-60% of HCC's excess wastewater by June 2003; extensive research continued with onsite options. Employed Launch Technology Ltd to review and recommend improvements to onsite options.		
Jul 2002	Carollo Engineers draft report was received on feasibility to discharge wastewater to Turlock Regional Water Quality Control Facility.		
5 Sep 2002	HCC submits a letter to the Regional Board regarding an update to the wastewater treatment system and plans to investigate sending wastewater to the Turlock Regional Water Control Facility.		
Oct 2002	First physico-chemical dissolved aeration (PCDAF) unit installed to remove suspended solids and replace failed VSep units.	\$1,094,590	
Jan-Dec 2002			\$5,751,181

Table 2, cont. Hilmar Cheese Company, Wastewater Treatment Activities and Expenditures, 1996-2005

Month / Year	Activity	Capital Expenditure	Annual Operational Expenditure
24 Feb 2003	Due to delay in EIR and lack of capacity, Turlock Regional Water Quality Control Facility indicated that they were no longer a viable processing option for HCC wastewater in the short term.		
Mar 2003	Eight sand filters installed to process PCDAF outflow prior to reverse osmosis processing.	\$212,292	
Jul 2003	Second DAF unit installed.	\$543,352	
Aug 2003	A second large secondary crossflow RO unit (RO#4) installed. Processing system included PCDAF, sand filters, two large primary RO units, one large and one small secondary RO unit, and an evaporator.	\$780,620	
Dec 2003	Construction begins on an Expanded Granular Sludge Bed (EGSB) anaerobic digester to convert organic loads into biogas (methane).	\$4,077,663	
Jan-Dec 2003			\$8,951,948
Apr 2004	Construction begins on Sequenced Batch Reactors (SBRs) for the removal of residual BOD and nitrogen.	\$3,605,575	
3 May 2004	HCC submitted letter to the RWQCB containing an outline of new RWD.		
Aug 2004	2004 RWD submitted to RWQCB.		
Sep 2004	Submission of Underground Injection Control permit application to EPA Region 9 to inject treated wastewater into deep wells. Submission of Groundwater Characterization Report to RWQCB.		
Sep 2004 to Present	Ongoing commission of EGSB and SBRs systems. Initiation of trials to run treated wastewater through RO. Trial use of UF membranes from Zenon to protect ROs from biofouling.		
4 Dec 2004	Revised 2004 RWD submitted to RWQCB.		
Jan-Dec 2004			\$8,671,691
27 Jan 2005	Water Supply Well Sampling Work Plan provided to RWQCB.		
Jan-Dec 2005	Estimated capital expenditure: installation of additional primary and secondary RO capacity, addition of Zenon UF units (post SBR and pre ROs), and ancillary equipment.	\$13,430,142	
Jan-Dec 2005			\$12,648,235
Total expenditure		\$41,037,573	\$44,262,265

Notes:

[1] Annual Operational Expenditures exclude depreciation.

Source:

[1] Hilmar Cheese Company, "Timeline of Treatment V5.xls."

B. Hilmar Went Beyond Existing Technology

Hilmar's substantial investment in wastewater treatment reflects the company's efforts to develop an innovative treatment technology that provided a low cost means not only to reduce EC, but BOD as well. Hilmar could not rely on a well defined best practice technology – none has been identified by the Regional Water Quality Control Board or any other government regulator. In addition, unlike some of its competitors, Hilmar could not rely on municipal wastewater treatment facilities either – no facility was reasonably accessible. Hilmar could not replicate the methods employed by municipal systems either. These systems enjoyed scale economies and opportunities for dilution unavailable to Hilmar or other cheese and food processors.

Faced with these constraints, Hilmar found it necessary to find new technologies and methods to control EC discharge. Hilmar was the first U.S. cheese company to implement the V-SEP technology. In an early version of the RWB Staff report, the RWB describes V-SEP as a promising technology, and stated that Hilmar should not be penalized for the period during which V-SEP was deployed:

The Regional Board should also encourage development of innovative alternative technology. Hilmar made known the promising results of the V-SEP system from pilot studies and its decision to implement it full scale without a conventional treatment system. Others companies in this industry also were convinced to try V-SEP and they experienced similar results. As the V-SEP system appeared to be a promising technology, Hilmar should not be considered culpable for failure of this technology in this application. Estimates of economic benefit should omit the period Hilmar relied upon the V-SEP and a reasonable period thereafter for implementation of alternate technology, and it should consider the sunk costs absorbed by Hilmar on the V-SEP technology against capital expenditures to replace it.²¹

Hilmar was also the first U.S. cheese manufacturer to use a high rate anaerobic digester. Since the late 1990's Hilmar has continuously attempted to find the right combination of technologies and processes to meet the EC limit.

²¹ "Staff Report, Administrative Civil Liability, Hilmar Cheese Company, Cheese Processing Plant, Merced County," Draft Version, RWB-000127-139, undated.

Hilmar's efforts to find a solution have provided valuable information to other cheese and food processors. Hilmar's experience with V-SEP educated others regarding its limitations. Similarly, Hilmar's experience with the RO process has provided lessons to others.

C. Hilmar Spent More Than Its Competitors

Not surprisingly, Hilmar has much higher compliance costs than its competitors. A cheese production cost comparison made by the California Department of Food and Agriculture, Dairy Marketing Branch, clearly demonstrates this.²² As shown in the table below, Hilmar's plants (designated as plants 1, 2 and 4) all report wastewater disposal costs more than three times the cost of other cheese plants in California.

Table 3. Wastewater Disposal Cost

	<u>\$/lb</u>	<u>Annual Cost</u>	<u>Hilmar to Average Ratio</u>
Hilmar Plant 1	0.0149	\$2,980,000	3.39
Hilmar Plants 2 & 4	0.0141	\$2,820,000	3.20
California Average	0.0044	\$880,000	n/a

Sources and Notes:

(1) Cost per lb from the California Department of Food and Agriculture, Dairy Marketing Branch.

(2) Annual cost based on annual production of 200 million pounds.

This comparison is likely to understate Hilmar's costs because it does not appear to include capital costs. The RWB Staff acknowledges that:

Despite failing to comply with the EC limit, HCC may have done more than any other members of the cheese industry with which it competes, and more

²² California Department of Food and Agriculture, Dairy Marketing Branch. Tables prepared for Hilmar Cheese Company. The Department includes wastewater costs in a category called "sewer and whey disposal." Also see <http://www.cdffa.ca.gov/>.

than other members of the food process industry in general, to limit the salt impact of its wastewater on groundwater.²³

The RWB Staff also noted that Hilmar was at a cost disadvantage relative to cheese producers with access to municipal wastewater treatment facilities:

“However, a comparison of HCC’s total waste disposal costs relative to industries that discharge to community sewerage systems shows that those discharging to the community sewerage system have had a significant economic advantage over HCC.”²⁴

D. Hilmar’s Exceedance of WDR Did Not Result from Inadequate Treatment Capacity

The RWB staff erroneously claims that Hilmar could have complied with the EC standard by adding additional treatment capacity.²⁵ However, Hilmar’s failure to fully comply was not caused by capacity constraints, but rather by the quality of the wastewater entering the treatment system and unstable wastewater chemistry during processing. This problem is explained in Hilmar’s supplemental report to the February 2001 Report of Waste Discharge:

The membranes of the ultrafiltration (UF) and the reverse osmosis (R/O) systems operate best at high pH. Occasionally and without warning, the pH in the wastewater drops significantly possibly due to bacterial activity in the equalization tanks or changes in the waste character... In some cases, the wastewater becomes untreatable with the membranes.²⁶

In fact, Hilmar believed it had extra RO capacity, but there was uncertainty regarding whether this capacity would solve the problem:

More redundancy in the UF and R/O units will help if fouled membranes compromise the flux rate or if Hilmar needs more membranes to process a low pH feed. However, this solution does not work when severe pH depression renders

²³ "Staff Report, Administrative Civil Liability, Hilmar Cheese Company, Cheese Processing Plant, Merced County," issued April 8, 2005.

²⁴ *Ibid.*

²⁵ *Ibid.*

²⁶ "Analysis of Upset Conditions Affecting Wastewater Treatment," Hilmar Cheese Company, 2001.

the waste untreatable. ... Hilmar also believes that the current R/O's are designed with 30% extra capacity.²⁷

More redundancy does not effectively treat wastewater when there are severe swings in pH. Nor does it overcome fouling and scaling problems in this type of wastewater. Hilmar engineers continue to make adaptations to their wastewater treatment system to overcome these problems. Hilmar is now also considering deep well injection as an alternative to the current system and has applied for a federal permit to test this approach with RWB's approval.²⁸

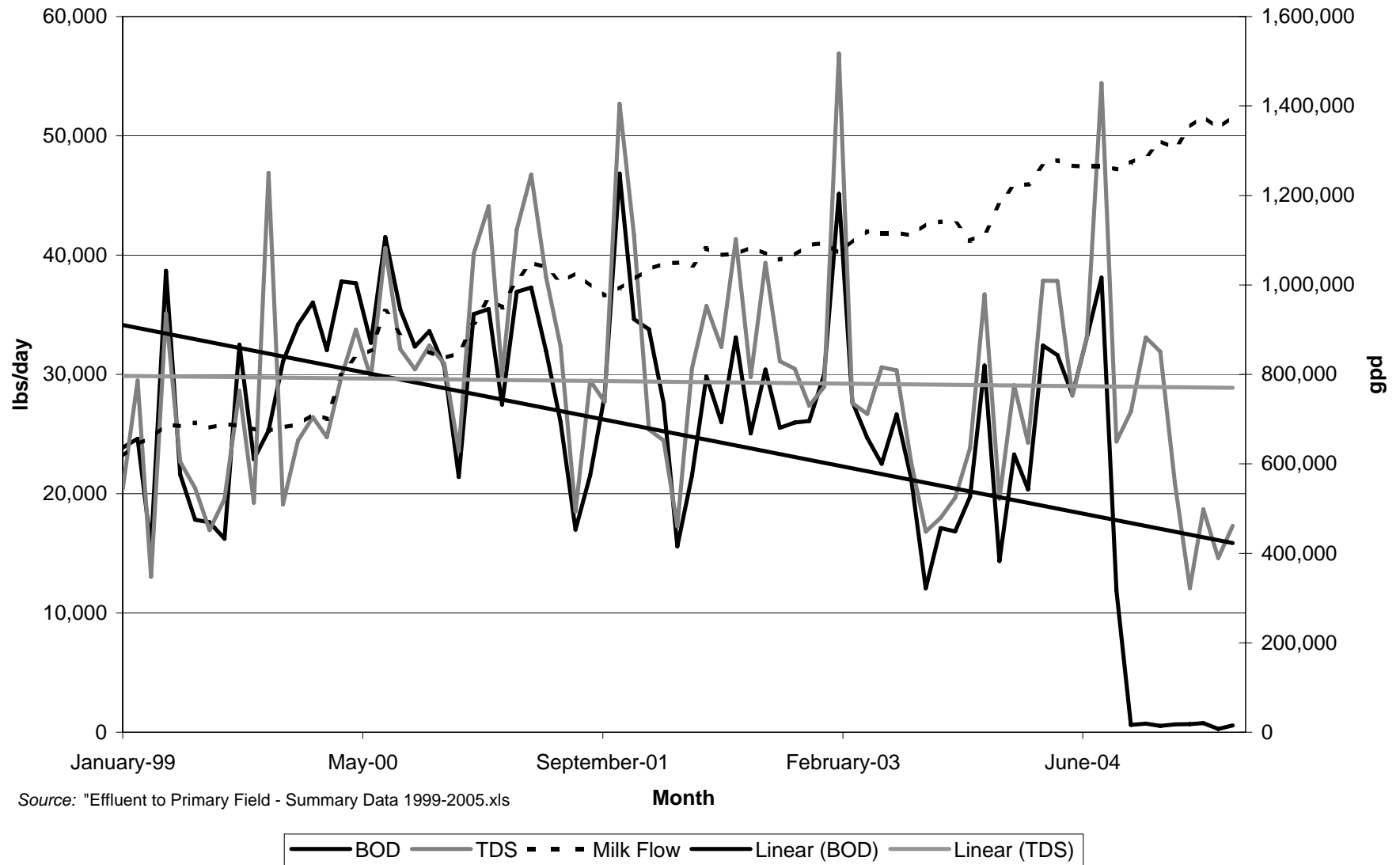
The RWB staff also contends that Hilmar's expansion led or contributed to exceedance of the EC limit. This conclusion ignores the fact that Hilmar's expansion plans included additional investment in compliance technology.²⁹ Hilmar's decision to expand was based on the expectation that expansion would not result in increased EC discharge and that continued efforts and expenditures would result in compliance. As shown in Figure 1, Hilmar's mineral loads did not increase despite a major increase in cheese production and in fact fell below the levels generated prior to expansion by 2005. In addition, this spending resulted in the near elimination of organic loading in recent months.

²⁷ "Analysis of Upset Conditions Affecting Wastewater Treatment," Hilmar Cheese Company, 2001, p.2.

²⁸ "Class I Underground Injection Control Permit Application," Submitted by Hilmar Cheese Company to US EPA Region IX, 2005.

²⁹ (1) "1998-2001 Expansion of Hilmar Cheese (HCC)," written by Jay Hicks for Sanwa Bank on January 28, 1998; (2) "Hilmar Cheese Expansion Status, July 29, 1999," (3) "Expansion Update, 2-May-02".

Figure 1. Organic (BOD) and Mineral (TDS) Loading to Primary Fields, January 1999 - May 2005



As an alternative to increasing treatment capacity, the RWB Staff suggests that Hilmar could have decreased production in order to reach compliance. Although this would have decreased the volume of wastewater, it would not necessarily have increased the effectiveness of waste treatment for the reasons discussed above. Moreover, reduced production would have caused substantial negative consequences to the local economy without commensurate improvement in environmental quality. This topic is discussed in greater detail in Section VII.

V. THE RWB STAFF'S CALCULATION OF HILMAR'S ECONOMIC BENEFITS SUFFERS FROM NUMEROUS DEFECTS

The RWB Staff estimates Hilmar's economic benefits from its EC exceedance by comparing Hilmar's actual expenditures on effluent disposal to either disposal costs at municipal wastewater treatment plants or to specific treatment processes it assumes would have enabled Hilmar to meet the EC limit.³⁰ In addition to its erroneous claim that Hilmar delayed or avoided compliance costs, this analysis is misleading for three reasons: (1) municipal waste water treatment costs are an improper metric for Hilmar's compliance costs; (2) neither a 1994 engineering report for Hilmar nor Hilmar's past investments represent a justifiable compliance cost benchmark for an alternative successful compliance effort; and (3) the RWB Staff has underestimated Hilmar's actual wastewater treatment costs by arbitrarily allocating Hilmar's wastewater treatment operating costs and by excluding wastewater treatment capital costs. Correcting for these errors using the RWB Staff methods, Hilmar has not gained any economic benefit from its failure to meet the EC limit. In addition, the RWB Staff has not relied on a sound alternative approach to attain compliance to serve as the basis for an economic benefit calculation, rendering its comparisons improper.

³⁰ "Staff Report, Administrative Civil Liability, Hilmar Cheese Company, Cheese Processing Plant, Merced County," issued April 8, 2005.

A. Municipal Treatment is an Improper Metric

The RWB Staff's benefit analysis compares Hilmar's costs of disposal to other municipal treatment facilities' costs of disposal, as summarized in the RWB Staff report, table 2.

This is an improper metric for two reasons. First, Hilmar did not have a municipal facility to send its discharge. Second, the costs of a municipal facility do not present a useful reference point for the costs of an individual industrial plant like Hilmar.

Hilmar has attempted to dispose of waste at municipal treatment plants. In February 2002, Hilmar began plans to dispose of PCDAF treated wastewater to the city of Turlock. Hilmar believed this would be a long-term solution to their wastewater, and planned to complete the pipeline in June 2003.³¹ But in February 2003, the City of Turlock ended negotiations with Hilmar due to concerns about capacity.³² Hilmar had already spent roughly \$100,000 in developing a pipeline to transport wastewater to Turlock.³³

Many other municipal treatment plants do not have adequate capacity to treat Hilmar water. Even if they did have capacity, constructing pipelines to municipalities other than Turlock would be extremely difficult. It would be very difficult to secure right-of-way for miles of pipeline. Additionally, the rivers in the area make an elaborate pipeline very difficult. Thus, trucking wastewater is the only means available to access a municipal treatment facility. Currently, Hilmar trucks 40,000 gallons of RO concentrate daily to EBMUD. Assuming available capacity, transporting 790,000 gallons of wastewater to EBMUD daily would cost over \$30 million annually (excluding disposal charges). Thus, trucking costs would render this option economically infeasible. To dispose of 821 million gallons of wastewater to EBMUD would have required 164,200 trucks and each truck would have traveled 190 miles round-trip. This would have resulted in approximately 56 tons of ROG (reactive organic gases), 655 tons of NO_x, and 15 tons of PM₁₀, as shown in the table below. To understand the magnitude of these impacts, we

³¹ Letter from Tedd Struckmeyer, Vice President Engineering and Business Development at Hilmar, to Stephen Klein, California Regional Water Quality Control Board, September 5, 2002.

³² Letter from Cliff Martin, Municipal Services Director for the City of Turlock, to Warren Climo, Hilmar Cheese Corporation, February 24, 2003. This letter states: "Although the City has capacity available to handle Hilmar's discharge for a short period of time, the window of opportunity for this to work without impacting potential new users within our service area is no longer available."

³³ Personal communication with Tedd Struckmeyer and Warren Climo.

have estimated total emissions for Merced County from heavy duty trucks for 2002 to 2004. Approximately 695 tons of ROG, 8065 tons of NO_x, and 181 tons of PM10 were emitted from heavy duty trucks from 2002 to 2004.

Table 4. Pollution generated from trucking 821 million gallons of wastewater to EBMUD.

Pollutant	g/mile [1]	Distance to EBMUD (miles) [2]	Total Discharge (gallons) [3]	Gallons/ Truck Load [4]	Total Truck Trips [5]	Total Emissions (Tons) [6]	Total Emissions from Heavy Duty Trucks in Merced County, 2002-2004 (Tons) [7]
ROG	1.64	95	821,000,000	5,000	164,200	56	695
NO _x	19.05	95	821,000,000	5,000	164,200	655	8065
PM10	0.43	95	821,000,000	5,000	164,200	15	181

Notes and Sources:

[1] Source: Emfac2002 v2.2 (Apr03), using default travel activity for trucks over 33,000 lbs. Averages 2002 and 2004 data.

[3] "Staff Report, Administrative Civil Liability, Hilmar Cheese Company, Cheese Processing Plant, Merced County," April 8, 2005.

[5]=[3]/[4]

[6]=(0.00000110 tons/gram)*[1]*2*[2]*[5], where 2*[2] is the round-trip distance for each truckload.

[7] Estimated as 365*(tons per day in 2002 + tons per day in 2004 + the average tons per day in 2002 and 2004). Tons per day in 2002 and 2004 provided by Doug Thompson at CARB.

Bert Van Voris, section chief of the Fresno office of the Central Valley Region Water Quality Control Board, asserted at deposition that the reference to municipal treatment costs was not meant to imply that Hilmar had access to such treatment. Rather he explained that:

The point was to establish an approximate cost of treating that strength of wastewater. And since municipalities apply biological treatment and charge for that treatment, that's a rough estimate of how much at a minimum it would cost.³⁴

This cost standard makes no sense. Treatment costs at a municipal treatment facility say nothing about the cost at a cheese or other food processing plant. The municipal system enjoys economies of scale not available to a single plant. The municipal plant also has opportunities to blend in order to dilute salt concentrations. This option is not available to a cheese plant.

B. The Board's Reliance on Alternative Compliance Efforts is Unrealistic

The RWB Staff's second compliance cost method relies on EPA's BEN model and refers to either an engineering study conducted for Hilmar in 1994 or Hilmar's recent compliance efforts to establish the costs Hilmar would have incurred if it had fully complied with the EC limit. Neither source provides a realistic benchmark for BEN modeling purposes.³⁵

The Nolte report prepared for Hilmar in 1994 presented a potential means to meet the EC Limit.³⁶ The RWB Staff assumes that the method described would have worked as described and inflates the cost estimate for this method to current dollars for purposes of comparison. There is absolutely no basis for this assumption. The proposed method was untested and more recent experience indicates that it would not have worked well. The

³⁴ Deposition of Bert Van Voris, Volume II, p.146

³⁵ (1) "Staff Report, Administrative Civil Liability, Hilmar Cheese Company, Cheese Processing Plant, Merced County," issued April 8, 2005.

(2) "Economic Benefit, Analysis for ACLC Staff Report, Hilmar Cheese Company, Merced County," from Alexis Phillips-Dowell, WRCE, April 26, 2005.

³⁶ "Proposed Technology-Based Treatment Unit Processes and Revised Reclamation Management Plan," Nolte and Associates, November 30, 1994.

method relied on reverse osmosis which has proved problematic at Hilmar in part because of the need to meet BOD as well as EC limits. The BOD limit was not contemplated in the Nolte report. In addition, the estimate prepared in 1994 in all likelihood was too low. Again more recent experience has demonstrated the complications in reverse osmosis. Adjusting for inflation is not adequate to account for higher costs related to these complications.

The second compliance cost estimate used by the RWB Staff assumes that Hilmar should have invested in more V-SEP capacity in 2001. This is an unrealistic assumption since Hilmar anticipated that the V-SEP capacity actually installed would be sufficient based on earlier testing. It was not until 2002 that Hilmar recognized that V-SEP would not work. The problems were with the scaling and fouling of the RO membranes that followed V-SEP, as well as V-SEP mechanical failures, rather than capacity. Hilmar moved to solve these problems by abandoning V-SEP and turning to anaerobic digestors. Consequently, the RWB Staff is basing its comparison for benefits calculations on a failed technology and a capacity unjustified at the time.

Although the RWB Staff relied on the two compliance approaches described above for the BEN calculations referenced in its Staff report, a supporting memo reveals that four other scenarios were considered.³⁷ These additional scenarios reveal that the RWB Staff had no clear alternative compliance method in mind. None of these additional scenarios reflects a suitable set of conditions for the BEN model.

For example, one of the additional scenarios relies on a compliance cost estimate based on the most recent compliance investments by Hilmar. The RWB Staff assumes that Hilmar could have simply made similar investments earlier to more quickly come into compliance. There is no sound basis for this assumption either. First, if the most recent investment works – which is not yet clear – the RWB Staff is relying on hindsight. Hilmar made the most recent investments only after failing at earlier attempts. The most

³⁷ "Economic Benefit, Analysis for ACLC Staff Report, Hilmar Cheese Company, Merced County," from Alexis Phillips-Dowell, WRCE, April 26, 2005.

recent investments benefit from the lessons learned over time. Hilmar would not have known to make the current investments earlier. Second, the most recent investments may fail. Thus, the RWB Staff, under this scenario, is using as a benchmark unproven technological investments.

C. The Board's Determination of Hilmar's Actual Compliance Costs is Arbitrary and Results in an Understatement of Such Costs

The RWB Staff understates Hilmar's actual compliance costs in two ways. First, the RWB Staff arbitrarily allocates only a portion of Hilmar's wastewater treatment operating costs for its benefits allocations. Second, the RWB Staff fails to account for Hilmar's capital costs for treatment. Understating Hilmar's costs results in overstating Hilmar's benefits from allegedly delaying compliance.

The RWB Staff arbitrarily allocates 10% of operating costs to primary land discharge and 90% of operating costs to secondary land discharge to determine Hilmar's actual compliance costs. This allocation is arbitrary and not supportable.

The RWB Staff justified this allocation, claiming that "it is reasonable to assume that the majority of both capital and operating expenditures pertain to the treated discharge to Secondary Lands."³⁸ It is hard to see how this is "reasonable." Hilmar attempted to pass all wastewater through RO membranes, but encountered technical difficulties.

Throughout the ACL, Hilmar was researching and developing the technology to adequately treat all wastewater. Because Hilmar was trying to treat all wastewater, the operation and maintenance costs should be applied to all of the discharge. The unfortunate result that Hilmar encountered technical difficulties does not mean that Hilmar spent less money on disposal for untreated water and more money for successfully treated water.

³⁸ "Staff Report, Administrative Civil Liability, Hilmar Cheese Company, Cheese Processing Plant, Merced County," issued April 8, 2005.

The RWB Staff's allocation of operation costs results in a very high cost of disposal to secondary fields. These costs make no sense. The RWB Staff indicates that treatment costs for comparable loading of wastewater at municipal treatment plants range from \$1.23 to \$12.99 per thousand gallons. The RWB Staff's assumptions result in Hilmar spending between 230% and 2429% of municipal treatment methods. This does not pass a reasonableness test. In addition, after allocating the great majority of Hilmar expenditures to water discharged to secondary fields, the RWB Staff ignores this spending, thus seriously understating Hilmar's compliance costs and seriously overstating Hilmar's economic benefit.

The RWB Staff further reduces Hilmar's costs by totally ignoring Hilmar's capital investments. Any calculation of the economic benefit gained by Hilmar must account for capital expenses. When capital costs are incorporated into the economic benefit analysis, it is clear that Hilmar's costs exceed the average cost of municipal waste water treatment facilities. Consequently, Hilmar's economic "benefit" is highly negative. We have incorporated Hilmar's capital expenditures on an annualized basis including the cost of debt. We present a revised version of the ACL Table 1 in Table 5.

Table 5. Hilmar's Wastewater Treatment Operating Expenditures and Annualized Capital Expenditures, 1998-2005.

Year	Annual Operating Expenditures, \$ [1]	Capital Expenditures, \$ [2]	Total annual discharge flow (1,000 gallons) [3]	Operating Costs \$/1,000 gallons [4]	New Capital Costs Annualized [5]	Total Annualized Capital Costs [6]	Capital Costs \$/1,000 gallons [7]	Total Cost / 1,000 gallons [8]
1998	\$946,701	\$3,458,616	293,673	\$3.22	\$369,316	\$369,316	\$1.26	\$4.48
1999	\$1,274,718	\$3,056,573	314,965	\$4.05	\$326,385	\$695,702	\$2.21	\$6.26
2000	\$1,587,562	\$1,837,662	431,723	\$3.68	\$196,228	\$891,930	\$2.07	\$5.74
2001	\$4,430,229	\$8,940,490	477,928	\$9.27	\$954,679	\$1,846,608	\$3.86	\$13.13
2002	\$5,751,181	\$1,094,590	485,544	\$11.84	\$116,882	\$1,963,490	\$4.04	\$15.89
2003	\$8,951,948	\$5,613,926	496,517	\$18.03	\$599,463	\$2,562,954	\$5.16	\$23.19
2004	\$8,671,691	\$3,605,575	569,101	\$15.24	\$385,009	\$2,947,962	\$5.18	\$20.42
2005	\$12,648,235	\$13,430,142	587,731	\$21.52	\$1,434,090	\$4,382,053	\$7.46	\$28.98
Average, 1998-2005	\$5,532,783	\$5,129,697	457,148	\$10.86	n/a	\$1,957,502	\$3.90	\$14.76
Average, 2002-2004	\$7,791,607	\$3,438,030	517,054	\$15.04	n/a	\$2,491,469	\$4.80	\$19.83

Notes and Sources:

[1],[2],[3],[4] from Table 1 of the Staff Report, except for 2005 discharge flow which is from "Effluent to Primary Field-Summary Data 1999-2005.xls"

[5]=Annualized payment stream of [2] given 10% interest rate for 20 years.

[6]=Sum of current year's annualized capital cost from [5] and previous years'.

[7]=[6]/[3]

[8]=[4]+[7]

Total costs per 1000 gallons as shown in Column 8 are substantially higher than operating costs alone as shown in Column 4. Hilmar's total costs (operating and capital) clearly exceed the average municipal treatment costs reported by the RWB Staff to range between \$1.23 and \$12.99 per 1000 gallons. Therefore, Hilmar has not enjoyed any savings relative to the costs of municipal treatment. Thus, following the RWB Staff method, Hilmar did not receive an economic benefit from avoiding or delaying compliance.

The RWB Staff also claims that as a result of expansion, Hilmar gained increased revenues from the increased cheese production without corresponding costs of compliance.³⁹ It is important to recognize that Hilmar's expansion was not financed by the avoidance of compliance costs. Hilmar's financial analysis supporting expansion accounted for compliance costs. The record of Hilmar's actual spending demonstrates a large increase in compliance costs post-expansion. Processed milk increased from 672,581 gpd to 1,258,985 between 1999 and 2004.⁴⁰ During this time, compliance costs increased from \$1,970,420 to \$11,619,653.⁴¹ This represents an increase from \$8.03 per thousand gallons of milk processed to \$25.29, or a 315% increase. As this demonstrates, Hilmar significantly increased its compliance costs concurrent with expansion.

D. RWB Staff Make Inappropriate Use of the BEN Model

To aid in the determination of a penalty, RWB Staff made extensive use of the BEN model to calculate Hilmar's gain from noncompliance. We are aware of six alternative estimates of economic benefit using this model.⁴² These estimates follow from various assumptions about what Hilmar should have been doing to comply with the WDR. It is telling that RWB Staff had such difficulty identifying the actions that would have brought Hilmar into compliance since the root of the problem is the failure of Hilmar's chosen

³⁹ "Staff Report, Administrative Civil Liability, Hilmar Cheese Company, Cheese Processing Plant, Merced County," April 8, 2005.

⁴⁰ "Effluent to Primary Field -Summary Data 1999-2005.xls"

⁴¹ See Table 5, summing operating costs and annualized capital expenditures.

⁴² "Economic Benefit, Analysis for ACLC Staff Report, Hilmar Cheese Company, Merced County," from Alexis Phillips-Dowell, WRCE, April 26, 2005.

technology to work as Hilmar and the RWB Staff had hoped, rather than a simple case of avoiding investment in a proven and easily identifiable technology.

The use of the BEN model to calculate Hilmar's economic benefit is highly inappropriate given the circumstances at hand. In comments recently published in the Federal Register, the US EPA reaffirms that the BEN model is designed to measure benefits that are received by a violator in three basic ways: "(1) Delaying necessary pollution control expenditures; (2) avoiding necessary pollution control expenditures; (3) obtaining an illegal competitive advantage."⁴³ Hilmar did not obtain any such benefits as a result of its exceedance of the EC limit in the WDR. As discussed above, Hilmar made required investments to have adequate design capacity to handle its production of wastewater, and made additional investments in advance of its product line expansion. Thus, it did not receive any benefits from delayed or avoided compliance expenditures. Further, Hilmar did not enjoy an "illegal competitive advantage" from noncompliance. Indeed, as pointed out above, it had higher compliance costs than its competitors.

VI. THE PROPOSED PENALTY IS NOT IN THE PUBLIC INTEREST

A. Overview

The RWB Staff's attempt to impose on Hilmar an unprecedented civil liability of \$4 million demonstrates a serious loss of perspective since the water quality impacts associated with Hilmar's operations have not been well demonstrated and are likely to be very small. Available evidence suggests that the proposed penalty greatly exceeds any current or foreseeable environmental damages resulting from Hilmar's exceedances. In addition, imposition of the proposed penalty will discourage cooperation with RWB Staff, and stifle efforts to develop new technologies and approaches to improve wastewater quality. Hilmar has attempted to comply using novel technology – encouraged by the RWB staff. Imposing a penalty of this magnitude on a cooperative firm willing to comply by making substantial investments in advanced technology will signal other firms that such efforts are not rewarded and may in fact be punished.

⁴³ Federal Register: August 26, 2005 (Volume 70, Number 165), Page 50326-50345.

Finally, the current EC limit was not based on a cost-benefit analysis. Compliance with an inefficient standard lowers social welfare, and residents of the Central Valley have much at stake in the debate over appropriate water quality standards. An optimal standard balances several public policy objectives, including protection of actual and future beneficial uses, creation of jobs and economic activity, and harnessing technological innovations to lower the cost of compliance. With respect to compliance costs, Hilmar already bears a much larger burden with respect to compliance costs than its competitors. Reductions in Hilmar's operations could result in a substantial loss to the regional economy in jobs and tax revenues. Further losses would result should Hilmar and other food processors be deterred from further investments in the San Joaquin Valley.

B. RWB Staff Has Failed to Measure Any Actual Damages Resulting From Hilmar's Actions

California State law defines beneficial use as waters used for "domestic; municipal; agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves (Water Code Section 13050(f))." The RWB Staff has not demonstrated that any of these uses is impaired as a consequence of Hilmar's exceedance with the possible exception of nuisance complaints by a small number of households that have been addressed by Hilmar. The RWB Staff has not identified any other users that have been affected. The RWB Staff appears to simply assume that the exceedance causes or is likely to cause some impairment. This assumption is not supported by specific evidence.

The RWB Staff report grimly asserts that "TDS, sodium and chloride are present in concentrations that would require management measures to avoid adversely affecting production of salt-sensitive crops." However, there is little evidence that groundwater used for crop irrigation has been impaired as a result of Hilmar's actions. Indeed, available evidence suggests that little, if any, actual injury to agricultural products has occurred as a result of Hilmar's exceedances.

The groundwater report by Brown and Caldwell identified 18 irrigation wells within a ½-mile buffer around Hilmar's operations.⁴⁴ Only 7 of these wells were operable and sampled. Of these wells, 4 have water quality that does not meet the 900 µmhos/cm secondary EC standard. IW-4 is owned by an owner of Hilmar. Another well, IW-3, is in a confined aquifer, and its EC is 1000 µmhos/cm. The third well, IW-17, is used for drainage and has an EC of 2000 µmhos/cm. The last well, IW-20, has an EC of 1500 µmhos/cm. This well is owned by an improvement district, implying that produced water is part of a broader conjunctive use program.

The area surrounding Hilmar Cheese is entirely within the service area of the Turlock Irrigation District. Thus, groundwater is not the primary water supply for fields in the region. Not surprisingly, we are not aware of any complaints made by growers in the vicinity of Hilmar Cheese relating to salinity and crop damage.

Even if groundwater used for irrigation is affected by Hilmar's exceedances, the RWB Staff has made no attempt to quantify actual or future damages that may result from changes in salinity. They have only offered generalities such as the following:

Depending on the salinity level in the irrigation water, the impact to plants can include reduced growth rate, reduced yield and death, which would be classified as 'detrimental physiological responses.'⁴⁵

Even a cursory analysis suggests that the magnitude of crop damage resulting from Hilmar's exceedances is likely to be small, in the unlikely event that any damage has occurred at all. Of the crops commonly grown in Merced and Stanislaus Counties, almonds are the most salt-sensitive. Even in this case, the available academic literature suggests some degree of salt tolerance. For example, a field irrigated entirely with groundwater with an EC of 1,400 µmhos/cm will experience a yield decline of only 10% *in a steady-state* (i.e., assuming that the field is irrigated with saline water forever),

⁴⁴ "Hilmar Cheese Company, Cleanup and Abatement Order No. R5-2004-0722, Water Supply Well Sampling Technical Report," Brown and Caldwell, July 11, 2005.

⁴⁵"Staff Report, Administrative Civil Liability, Hilmar Cheese Company, Cheese Processing Plant, Merced County," April 8, 2005, p.11.

assuming a leaching fraction of 30%.⁴⁶ Even under the assumption that the field is entirely irrigated with groundwater, at current almond prices the value of the yield loss would be roughly only \$250 per acre per year.⁴⁷

Even in this extreme case, there would be options available to a grower to mitigate impairments in water quality. One possibility would be to blend surface and groundwater, or to use entirely surface water, as is the case with most of the fields surrounding Hilmar Cheese. Another possibility is to drill deeper to avoid any salinity caused by Hilmar's operations. Incremental costs associated with deeper drilling include the capital costs of drilling a new well plus extra pumping lift. Capital costs of deep drilling, including casing and bowl costs, are unlikely to exceed \$30,000 for a 250-foot well of sufficient size to service 100 acres.⁴⁸ The annualized cost of deep drilling is approximately \$35 per acre. The incremental lift costs would be roughly \$25 per acre-foot assuming an extra 100 feet of lift. Taking capital and operating costs together, the incremental cost of drawing groundwater from a 250-foot well is less than \$160 per acre per year.⁴⁹

While the RWB Staff made no attempt to quantify, let alone value, agricultural damages resulting from Hilmar's exceedances, it appears highly unlikely that such losses approach the proposed penalty. Four million dollars is the present value of the capital and operating costs of deep drilling on over 2,000 acres; at a price of \$4,000 per acre, it is the cost of permanently fallowing 1,000 acres of farmland. There is no evidence that such dramatic effects will occur as a result of Hilmar's actions, and the proposed penalty appears to be disproportionate to any agricultural damages.

⁴⁶ Grattan, S. "Irrigation Water Salinity and Crop Production," Division of Agriculture and Natural Resources, University of California, Publication 8066, 2002.

⁴⁷ "Sample Costs to Establish an Almond Orchard and Produce Almonds, San Joaquin Valley North," University of California Cooperative Extension, 2002.

⁴⁸ (1) Selley, R., "Estimated Irrigation Costs, 2001," University of Nebraska Cooperative Extension, Publication CC 371, August, 2001.

(2) Dumler, T. and D. Rogers, "Irrigation Capital Requirements and Energy Costs," Kansas State University Agricultural Experiment Station, Publication MF-836, October 2004.

⁴⁹ Assumes 5 acre-ft per acre.

The RWB also claims that Hilmar is affecting groundwater used for domestic uses including drinking water. The Board asserts that wells “within the influence of Hilmar’s wastewater discharge contain an EC ranging from 1,200 to 3,400 $\mu\text{mhos/cm}$.”⁵⁰ The EC drinking water standard is a secondary maximum contaminant level (MCL) that pertains to taste rather than health considerations. The recommended MCL for EC is 900 $\mu\text{mhos/cm}$. The upper limit for EC is 1600 $\mu\text{mhos/cm}$ and the short-term limit is 2200 $\mu\text{mhos/cm}$.⁵¹ The only claimed damages are nuisance damages related to water odor and/or taste. To date, only six households have complained about taste or odor problems of their well water. In all of these cases, it is not clear that these problems can be attributed to EC associated with Hilmar’s activities.⁵² Other contaminants from other sources may be at fault.

There are two simple methods that can be employed to measure economic losses from changes in the salinity of drinking water. The costs of providing bottled water provide a lower bound assessment of the costs of changes in drinking water quality. In fact, Hilmar has voluntarily paid for bottled water for these households.⁵³ Hilmar spends roughly \$3,000 annually on bottled water for the six households in question.⁵⁴ The present value of providing bottled water indefinitely is approximately \$30,000.

The second approach is to measure the cost of replacement of all groundwater with an alternative water source. Drilling deeper wells for these six households would cost between \$5,000 and \$7,000 per well.⁵⁵ Including incremental lift costs in the same manner as for agriculture, wells for six households would cost less than \$750 annually for each household, for a total of \$4,500 annually. Thus, even under this approach, drinking

⁵⁰“Staff Report, Administrative Civil Liability, Hilmar Cheese Company, Cheese Processing Plant, Merced County,” issued April 8, 2005.

⁵¹ Article 16. Secondary Drinking Water Standards, Section 64449. Secondary maximum contaminant levels and compliance, Table 64449-A, Secondary Maximum Contaminant Levels, Consumer Acceptance Limits.

⁵² “Hilmar Cheese Company, Merced County, California, Report of Waste Discharge,” Brown and Caldwell, revised December 2004.

⁵³ As acknowledged by Board Staff. Hilmar has successfully mitigated two other nuisance claims – odor and flies – by improved soil management.

⁵⁴ Water costs provided by Hilmar Cheese Company.

⁵⁵ Personal communication with Warren Climo.

water damages would be less than \$45,000 assuming permanent replacement of the current drinking water supply.⁵⁶

Thus, actual damages to drinking water supplies are far less than the proposed penalty of \$4 million. The RWB Staff made no attempt to identify or quantify any drinking water damages at all.

The sum of potential damages to drinking water and irrigation are likely to be dramatically lower than the proposed penalty. Thus, the unprecedented magnitude of the penalty cannot be justified. The highest previous proposed penalty imposed by the RWB, \$3 million in 1995 (\$3.85 million in 2005 dollars), was in response to a discharge by the Kern Oil Company involving known hazardous substances.⁵⁷ The actual settlement was substantially lower. Here, the Board is faced with an exceedance with little, if any, environmental impacts and no human health impacts.

C. The Minimal Potential Damages Raise Concerns Regarding the Efficiency of the Standard

As a general matter, we note that the underlying water quality standard of 900 $\mu\text{mhos/cm}$ does not appear to have been subjected to any cost-benefit scrutiny. The EC limit imposed by the Board is based on the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins (Basin Plan). Importantly, however, the Basin Plan does not rely on an analysis of how EC levels affect the beneficial uses of the basins. Instead it cites to the California Code of Regulations, Title 22.⁵⁸ This Title recommends an electrical conductivity level to maintain water for municipal use of 900 $\mu\text{mhos/cm}$, but also identifies an upper limit of 1,600 $\mu\text{mhos/cm}$ and a short term upper limit of 2,200 $\mu\text{mhos/cm}$. This is a secondary water limit which appears to be a taste threshold. We have found no legislative history explaining the basis for these limits.

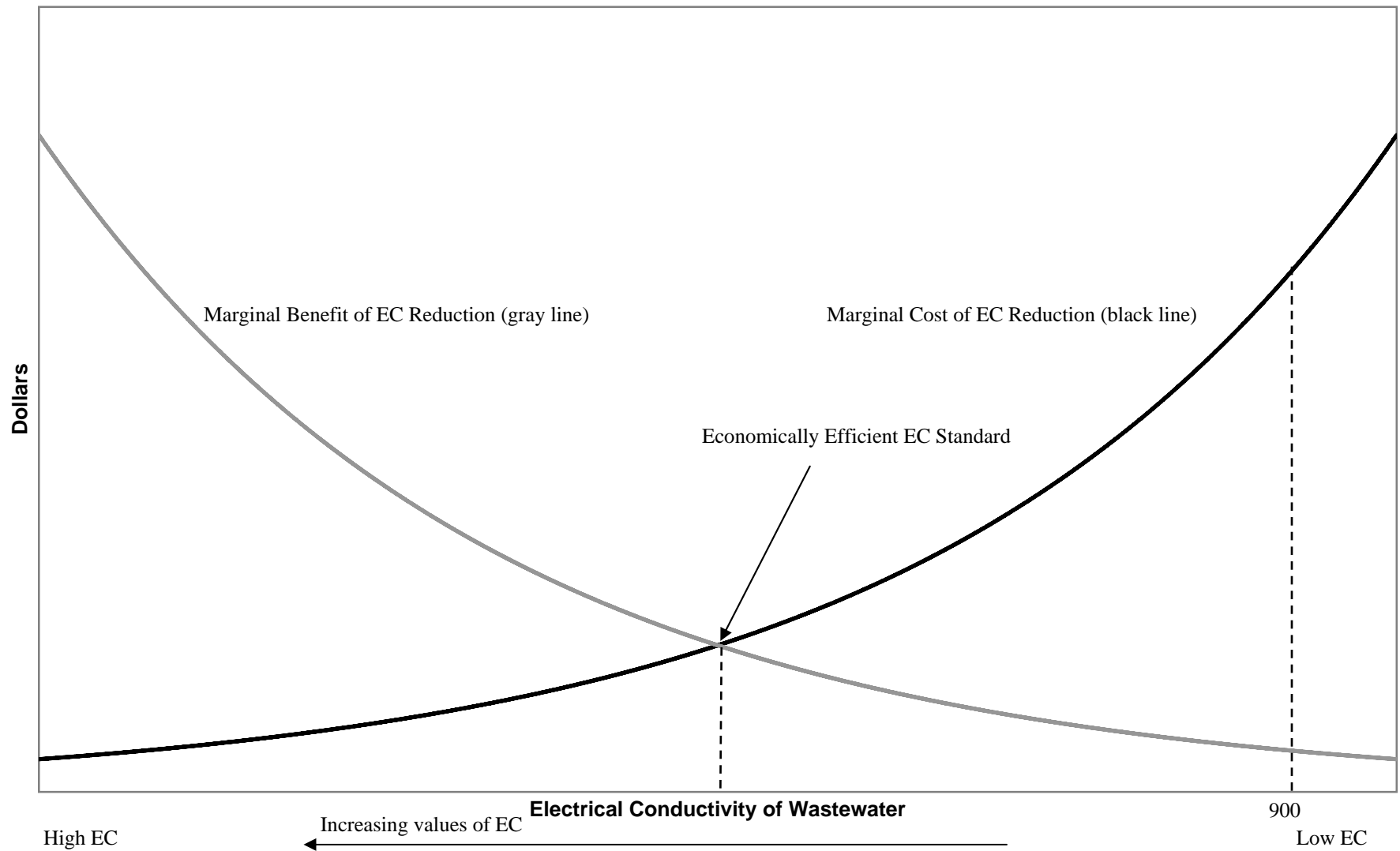
⁵⁶ Assumes 1 acre-foot of water per year for each drinking well.

⁵⁷ Deposition of Loren Harlow, August 18, 2005, p.55.

⁵⁸ Title 22, California Code Of Regulations, Article 16. Secondary Drinking Water Standards, Section 64449, Secondary maximum contaminant levels and compliance.

An economically efficient limit is set by determining where the marginal benefit of reduced environmental harm equals the marginal cost of making that reduction. Figure 2 illustrates this efficient point. There is no evidence that the EC limit reflects this point. In fact, since the benefits of reduced EC are very small relating to taste and odor rather than to harm to the environment, agriculture, or human health, and the costs of compliance are so high, an efficient limit is likely to be much higher. Referring again to Figure 2 the point of intersection is much further to the left. The current EC standard appears to impose high costs for very limited benefits.

Figure 2. Economically Efficient Standard for Electrical Conductivity



D. Enforcement of the Water Quality Standard May Impose Serious Impacts on Hilmar and the Local Economy.

Compliance costs make it financially unattractive for Hilmar to expand in California and more difficult to compete nationally. As discussed above, Hilmar accounted for wastewater treatment costs when the company made the decision to expand in the late 1990's. It is unclear whether they would make the same decision now based on the actual treatment costs they have incurred to date and additional costs they may be required to make in the near future. Certainly any further expansion is unlikely without clearer resolution of the EC limit. Potential lenders and investors may be unwilling to work with Hilmar if future operations are likely to be curtailed.

Hilmar's expansion decisions will be driven by the costs of operating in California compared to other locations. Hilmar must account for factors such as environmental compliance costs, milk costs, labor costs, and proximity to market. Hilmar, has in fact considered other locations for further expansion.

The consequences of a Hilmar production reduction or shutdown on the local economy are substantial. We quantified the effects of Hilmar on the economy of Merced County using IMPLAN Economic Modeling Software.⁵⁹ The IMPLAN Model is a widely used tool for analysis of economic events such as a change in industrial output. IMPLAN was developed by the U.S. Forest Service, which continues to use it today, and is now also used by 1,500 agencies and companies, including the San Diego Association of Governments, the California Energy Commission, the California Departments of Finance, Transportation, Water Resources, and Labor and Employment, San Diego State, Stanford, U.C. Berkeley, and numerous private consulting companies.⁶⁰

⁵⁹ MIG, Inc., IMPLAN Professional Version v.2.0.1024, 1997-2004.

⁶⁰ <http://www.implan.com/references.html>

The core of IMPLAN is an input-output model. This type of model traces the “multiplier effect” of an industry making purchases from other industries.⁶¹ The economy is described by 509 IMPLAN industry sectors, which are based on the North American Industry Classification System (NAICS) and the Bureau of Economic Analysis (BEA) commodity classifications. “Direct effects” are the changes in final demand being modeled (the goods and services produced or purchased from an industry). “Indirect effects” estimate inter-industry purchases. Regional purchase coefficients are used to estimate the proportion of inter-industry purchases occurring within the study area. In addition to the interactions between the 509 IMPLAN industries, “induced effects” estimate the impact of household spending caused by the change in final demand.⁶² In the table and discussion that follow, the sum of indirect and induced effects are referred to as secondary effects.

We modeled the economic impact of Hilmar in 1999, a year preceding Hilmar’s capacity expansion, and in 2004, the last complete year of data. The comparison of these impacts describes the effects of Hilmar’s recent expansion. Hilmar provided data on revenue, labor expenses, and number of employees. IMPLAN data include estimates of the output per worker (the dollar value of cheese associated with the employment of one worker). The output per worker estimated in the IMPLAN data was different from the data provided by Hilmar. Consequently, we used Hilmar data to customize the IMPLAN model as described below.

Cheese manufacturing is described by IMPLAN sector 64. Whey manufacturing is described by Sector 65.⁶³ For 2004, revenues and labor data were broken down between

⁶¹ For a detailed discussion of this modeling method see, Ronald Miller and Peter Blair, *Input Output Analysis, Foundations and Extensions*, New Jersey: Prentice Hall.

⁶² Direct impacts – the direct purchases by the facility under study – and indirect impacts –the purchases made by the firms supplying the facility – are captured in the standard input-output model. Induced impacts – purchases by employees of the facility and indirect firms – are captured when the model is “closed” with respect to households. The version of IMPLAN used here is closed.

⁶³ IMPLAN User’s, Analysis, and Data Guide, 3rd Edition, 2004, Appendix A, p.292. IMPLAN describes sector 64 as “cheese manufacturing.” IMPLAN describes sector 65 as “dry, condensed, and evaporated dairy products,” and lists 311514 as the corresponding NAICS code. Searching for whey on the census website, whey comes up in both 311513 (cheese manufacturing) and 311514. The index entry for NAICS 311513 is “Whey, raw, liquid, manufacturing,” while NAICS 311514 is “Whey, condensed, dried,

cheese, whey, and another category. The other category seems to correspond to the visitor center when describing the components of the revenue breakdown. The other category seems to include management in the labor breakdown. Because of the inconsistent aggregation of the other category, it does not seem practical to allocate these values to another IMPLAN sector. Consequently, we allocate “other” to Sectors 64 and 65. Values are allocated to Sector 64 according to the sales in 64 as a fraction of sales in 64 and 65. Values are allocated to Sector 65 according to the sales in 65 as a fraction of sales in 64 and 65.

The output per worker in 1999 was different from 2004. Consequently, different models were created to estimate the impact of Hilmar in 1999 versus 2004. In 2004, Sectors 64 and 65 were customized. In the 1999, only Sector 64 was modified. Prior to 2004, whey was marketed by a separate company and revenue figures are not available.⁶⁴ The output per worker was estimated based on the data provided by Hilmar. IMPLAN was then calibrated to this revised output. Hilmar’s output per worker was higher than IMPLAN data. The increased productivity of employees at Hilmar resulted in less employee compensation than in the IMPLAN data. The difference in employee compensation between the IMPLAN data and Hilmar-calibrated IMPLAN data is allocated to other property type income.⁶⁵ Only the value-added component of IMPLAN data is customized, where value-added includes employee compensation and other property type income. The ratio between the value-added components of industry output and the necessary inputs from other industries is kept the same. In other words, we use IMPLAN’s estimate of the amount of industrial input necessary to achieve a dollar output of cheese or whey.

Results are presented in the table that follows. As shown in this table, the secondary impacts of Hilmar on Merced County are large and significant. The secondary impacts of

evaporated, and powdered, manufacturing.” The latter index entry is more consistent with Hilmar’s product. Search for “whey” at <http://www.census.gov/econ/census02/data/us/US000.HTM>. A description of Hilmar’s whey products is available at <http://www.hilmarcheese.com/hilmaringredients/default.aspx>. Note that all the protein and lactose products are powder.

⁶⁴ <http://www.hilmarcheese.com/hilmaringredients/default.aspx>

⁶⁵ Other property type income is synonymous with corporate profits.

the expansion alone include 3,225 jobs, over \$67 million in labor income, and nearly \$435 million in business at other industries. This demonstrates the positive stimulus of Hilmar on other businesses in Merced County. In fact, the total impact of Hilmar through direct and secondary impacts represents 18% of industrial output, 9% of employment, and 7% of labor income in Merced County. Hilmar's expansion alone has generated approximately \$24 million in local and state tax revenues as well.

Table 6. The effect of Hilmar on the economy of Merced County (in 2004 dollars).

	Direct	Secondary	Total
	[1]	[2]	[3]=[1]+[2]
<u>II</u>			
<u>Impacts 1999 (Pre-Expansion):</u>			
Industry Output	\$397,051,000	\$484,808,000	\$881,859,000
Labor Income	\$18,172,000	\$74,038,000	\$92,210,000
Employment	316	3,583	3,899
Taxes to state and local government			\$30,006,000
<u>III</u>			
<u>Impacts 2004 (Post-Expansion):</u>			
Industry Output	\$782,273,000	\$919,678,000	\$1,701,951,000
Labor Income	\$35,733,000	\$141,072,000	\$176,805,000
Employment	603	6,808	7,411
Taxes to state and local government			\$54,170,000
<u>III]=[II]-[I]</u>			
<u>Incremental Impact of Expansion:</u>			
Industry Output	\$385,222,000	\$434,870,000	\$820,091,000
Labor Income	\$17,561,000	\$67,034,000	\$84,594,000
Employment	287	3,225	3,512
Taxes to state and local government			\$24,164,000
<u>IV</u>			
<u>Merced County Data [3]</u>			
Industry Output			\$9,276,379,800
Labor Income			\$2,408,409,720
Employment			86,542
<u>V</u>			
<u>2004 Impacts as a Percent of Merced County Data</u>			
Industry Output			18%
Labor Income			7%
Employment			9%

Sources:

[1] Hilmar Financial Data.

[2] IMPLAN modeling.

[3] IMPLAN data.

E. Reducing Compliance Cost is in the Public Interest

Vast amounts of resources are devoted to compliance with water quality objectives. A recent study calculated that the costs of compliance with water quality regulations in the United States totaled \$93 billion in 2001.⁶⁶ Environmental economists have argued that efforts to reduce the cost of compliance with water quality regulations are a public good and should be encouraged. Innovation in compliance technology provides benefits to producers and consumers, lessens conflicts over environmental protection, and can ultimately lead to improved levels of environmental quality.

Innovation often entails a period of experimentation and “learning by doing.” Some attempts at innovation are doomed to fail, but are worthwhile nonetheless. Even successful efforts at innovation produce cost reductions that increase over time, implying that mastery of new technology does not come immediately.

The Board should be encouraging permittees to work with RWB Staff to develop innovative treatment technologies. In a draft version of the RWB Staff Report, the Board recognized this:

The Regional Board cannot specify the manner of compliance. The Regional Board should also encourage development of innovative alternative technology... As the VSEP system appeared to be a promising technology, HCC should not be considered culpable for failure of this technology in this application.⁶⁷

It should be noted that the Central Valley is projected to experience rapid population growth in the near future. A 2005 report by the Public Policy Institute of California concluded that the population of California will grow to at least 45 million by 2040, and that the San Joaquin Valley is a “likely outlet” for this population pressure:

At the outset of the 21st Century, the San Joaquin Valley stands on the threshold of the second great transformation in the 150 years of its settlement by Mexicans and Americans. ... Now with forecasts of population growth that would double its population

⁶⁶ Johnson, J., “The Cost of Regulations Implementing the Clean Water Act,” Regulatory Studies Program, Mercatus Center, George Mason University, March 2004.

⁶⁷ "Staff Report, Administrative Civil Liability, Hilmar Cheese Company, Cheese Processing Plant, Merced County," Draft Version, RWB-000127-139, undated, at RWB-000135.

in the next 40 years from 3.3 million to over seven million, the Valley faces urbanization on an unprecedented scale.⁶⁸

Given the need to improve water quality and accommodate the migration of millions of new residents to the Central Valley, it would seem prudent for the Board to help reduce compliance costs by encouraging flexibility and innovation.

Further, this discussion highlights (yet again) the continuing need for the State to come to grips with the long-term salt imbalance that exists in the San Joaquin Valley. The Basin Plan states that the best long-term solution to this problem is the creation of a valley-wide drain to move water with high EC out of the region.⁶⁹ Other possible solutions include deep well injection, construction of a central brine disposal line, and innovative institutions such as “cap and trade.”⁷⁰ Hilmar’s experiences are indicative of the current, relatively ad hoc, approach to salinity management, which is not likely to result in an optimal solution to the Region’s salt imbalance.

⁶⁸ Tietz, M., C. Dietzel and W. Fulton, *Urban Development Futures in the San Joaquin Valley*, Public Policy Institute of California, 2005.

⁶⁹ The Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control Board Central Valley Region, 4th edition, revised September 2004 (with approved amendments), the Sacramento River Basin and the San Joaquin River Basin, p.IV-15.00.

⁷⁰ See for example, Hall, Lynde, and Raffini, “Water Quality Trading: Where Do We Go From Here,” *Natural Resources and Environment*, Vol. 20, No. 1, pp.38-42, Summer 2005.

VII. APPENDIX A. RESUMES

MARK P. BERKMAN

Vice President

Ph.D. Program in Public Policy
Analysis, Wharton School
University Of Pennsylvania—
Graduate Group in Managerial
Science and Applied
Economics

M.A. Planning, Policy Analysis
and Administration Program
Harvard University

B.A. Economics and Urban
Affairs, George Washington
University

Dr. Mark Berkman is an expert in regulation and antitrust economics. He has assisted public and private clients often providing testimony before the courts, regulatory bodies, and legislatures. Dr. Berkman's experience spans environmental, energy, intellectual property, antitrust, labor, and public finance matters. His environmental work includes the review of proposed air, water, solid waste, and worker and product safety regulations. Dr. Berkman has often quantified the costs and benefits of these regulations as well as toxic tort and product liability claims. He has also valued natural and water resources as well as property damages associated with pollution from Superfund sites, landfills, and power plants. Dr. Berkman's work on energy matters includes the valuation of coal resources, power plants, and transmission right-of-ways. He has also prepared energy demand and price forecasts. Clients in a variety of industries ranging from computer chip to shoe manufacturers have sought Dr. Berkman's assistance to value patents, trade secrets, and trademarks. He has frequently presented his valuations before the courts and arbitration panels. Dr. Berkman has also been called on to address questions of market power in a variety of industries including solid waste, computer manufacturing, and medical devices. He has testified before the courts regarding market definition and market power and participated in Hart Scott Rodino proceedings. Dr. Berkman has also provided counsel to clients regarding labor disputes often leading to testimony. He has studied the statistical evidence regarding claims of race, age, and gender discrimination in hiring, promotion, and pay for plaintiffs and defendants in numerous industries including law enforcement and banking. He has also prepared damage estimates related to these claims.

EXPERIENCE

2002–Present *Vice President*, CRA International

Responsible for managing and conducting projects in environment, energy, intellectual property, antitrust, labor, and public finance.

1983–2002 National *Economic* Research Associates, Inc.

Vice President, 1993–2002

Senior Consultant, 1988–1993

Senior Analyst, 1984–1988

Economic Analyst, 1983–1984

1980–1983 *Research Fellow*, University Of Pennsylvania

Studied the regional economic impacts of federal coal policy under a dissertation fellowship from the Regional Science Association and the Economic Development Administration. Analyzed federal coal leasing policy for the Department of Energy. Reviewed the market potential of solar energy technologies for the Energy Research Advisory Board. Conducted a commercialization study of fuel cells for the Department of Energy.

1977–1980 *Associate Budget Analyst*, Congressional Budget Office

Prepared cost estimates of pending energy and science legislation and developed five-year projections of the federal budget in these areas. Analyzed President's budget proposals and conducted energy policy studies. Testified before several Congressional committees.

1976–1977 *Teaching Assistant*, Harvard University

Conducted review sessions, graded papers, and provided extra help in two courses: Economics for Planners and Urban and Regional Economics.

1975–1976 *Research Assistant*, The Urban Institute

Prepared contract reports and working papers and collected and managed data on topics in the fields of housing and transportation.

1973–1975 *Staff Assistant*, United States Congress, Office of Congressman Charles Vanik

Conducted legislative research and prepared position statements.

PROFESSIONAL ACTIVITIES

American Economic Association

Association for Public Policy Analysis and Management

Association of Environmental and Resource Economists

Western Economic Association

TESTIMONY AND CONSULTING REPORTS

Energy, Environment, Health and Safety

“Environmental liability forecasts regarding manufactured gas plant sites for Pacific Gas & Electric,” September 2004. (Confidential)

Expert Report of Mark Berkman in the matter of *BFI Waste Systems of North America, Inc. v. City and County of Denver and Waste Management of Colorado, Inc.* on behalf of the plaintiff. Filed in the United States District Court for the District of Colorado. August 30, 2004.

Affidavit of Mark Berkman in the matter of the *Navajo Nation v. United States of America*, on behalf of the Navajo Nation. Filed in the United States Court of Federal Claims. August 20, 2004.

Testified before the Public Utilities Commission of the State of California on behalf of the Navajo Nation, in the matter of the Application of Southern California Edison Regarding the Future Disposition of the Mohave Generating Station. June 23, 2004.

Prepared Superseding testimony of Mark P. Berkman, Ph.D., before the Public Utilities Commission of the State of California on behalf of the Navajo Nation, in the matter of the Application of Southern California Edison Regarding the Future Disposition of the Mohave Generating Station. May 14, 2004.

“Preliminary Estimate of Revenues Derived by Wyoming and Fremont county from Residents and Businesses on the Wind River Reservation and Expenditures by Wyoming and Fremont County for Services to the Reservation, 1988-2002,” prepared by Mark Berkman and Benjamin Arnold for the Northern Arapaho and Shoshone Business Council. November 18, 2003

Deposition Testimony in the matter of *Seng v. Levitz et al.* in the Superior Court of the State of Washington, in and for Snohomish County, on behalf of the defendants regarding product liability. Oakland, California, August 27, 2003.

Prepared Direct Testimony of Mark P. Berkman before the Public Utilities Commission of the State of California on behalf of the Navajo Nation in the matter of the Application of Southern California Edison Regarding the Future Disposition of the Mohave Generating Station. March 28, 2003.

Expert report in the matter of *United Haulers Association, Inc. et al. v. Oneida-Herkimer Solid Waste Management Authority, County of Oneida and County of Herkimer* before

the U.S. District Court for the Northern District of New York. Performed an analysis on behalf of the plaintiffs of the solid waste flow control laws enacted by Oneida and Herkimer Counties, New York. November 15, 2002.

“Forecast of Environmental Remediation Liability for Pacific Gas & Electric.” With Gordon Rausser, October 10, 2002.

“The Economic Impacts of Closing the Canton Mill.” With Burton Griffith. Prepared for Blue Ridge Paper Products, Inc., June 1, 2001.

“Assessing the Need for a Federal Small Open Flame / Cigarette Ignition Upholstered Furniture Flammability Standard.” On behalf of the Upholstered Furniture Action Council, February 16, 2001.

“A Review of the Federal Motor Carrier Safety Administration’s Economic Analysis for its Proposed Hours of Service Standard.” Prepared for the American Trucking Associations, August 3, 2000.

“Estimates of Environmental Risk Associated with the BMI Site.” Prepared for Marsh & McLennan, March 2000.

“A Review of OSHA’s Economic Analysis For Its Proposed Ergonomics Standard.” On behalf of the National Coalition on Ergonomics, February 29, 2000.

“The Effect of CO₂ Reduction Policies on the Canadian Electricity Industry and Economy.” Prepared for ATCO Electric, EPCOR, New Brunswick Power, Nova Scotia Power, Ontario Power Generation, Saskatchewan Power and TransAlta Utilities, July 5, 1999.

Affidavit of Mark P. Berkman, prepared on behalf of the Crow Tribe of Indians, in the matter of *Crow Tribe of Indians v. State of Montana*, October 30, 1998, regarding the impact of Montana taxes on the Crow Tribe’s ability to manage its coal resources.

“The Economic Impacts of Policies to Reduce Alfalfa Water Consumption.” Report, prepared for Natural Resources Defense Council, October 12, 1998.

“Market Opportunities for Environmental Remediation and Site Management” Report prepared for Pacific Corp, 1998.

“Comments on CalFed’s Draft EIS of March 1998.” Prepared for Save San Francisco Bay Association, June 30, 1998.

“Evaluation of Tax Claim Against the State of Montana.” Prepared for the Fort Peck Reservation, September 18, 1997. (Confidential)

Deposition Testimony on behalf of homeowners in Benicia, California, regarding property value diminution in *Lagrimas v. Southhampton et al.*, September 1997.

Testimony before the U.S. House of Representatives Committee on Education and the Workforce on behalf of the American Trucking Association regarding the costs and benefits of a proposed ergonomics standard, July 1997.

Testimony before the Trade Waste Commission, City of New York, January 21, 1997, on behalf of the New York City Economic Development Commission, regarding maximum rate regulation of commercial waste collection.

“Costs and Benefits of the Proposed Enclosed Unloader at the Fresh Kills Landfill.” Prepared for the New York City Law Department, December 1996.

“Benefit-Cost Analysis of OSHA’s Proposed Ergonomics Standard on the Trucking Industry.” On behalf of the ATA Foundation, September 1996.

Rebuttal Testimony on behalf of Central and South West Energy, Inc. in the matter of Application No. 93-2, CSW Energy, Inc. and KVA Resources, Inc., Northwest Regional Power Facility, Before the State of Washington Energy Facility Site Evaluation Council, October 1995, regarding the costs and benefits of controlling residual NO_x and CO emissions and CO₂ emissions at a proposed natural gas-fired power plant in Washington.

Affidavit on behalf of the New York City Law Department, in the matter of the Application of New York City Department of Environmental Protection for Renewals of the State Pollutant Discharge Elimination System Permits for New York City’s 14 Publicly Owned Treatment Works, August 24, 1995, regarding the costs and benefits of proposed pollution control investments.

Deposition Testimony on behalf of Browning-Ferris Industries, in the matter of *W.J. Curry & Son v. Velsicol Chemical Co. v. Kraft et al.*, July 12, 1996, regarding the allocation of Superfund remediation costs.

“Estimating Employment Effects of Electric Price Increases in U.S. Manufacturing Industries and Assessing Such Effects in New Jersey.” Prepared for Jersey Central Power & Light, June 28, 1996.

“Estimate of Employment Effects of Electric Price Increases in U.S. Manufacturing Industries and Assessing Such Effects in Maryland.” Prepared for Allegheny Power, Maryland, June 17, 1996.

Rebuttal Testimony on behalf of Central and South West Energy, Inc. in the matter of Application No. 93-2, CSW Energy, Inc. and KVA Resources, Inc., Northwest Regional Power Facility, Before the State of Washington Energy Facility Site Evaluation Council, October 1995, regarding the costs and benefits of controlling residual NO_x and CO emissions and CO₂ emissions at a proposed natural gas-fired power plant in Washington.

Affidavit on behalf of the New York City Law Department, in the matter of the Application of New York City Department of Environmental Protection for Renewals of the State Pollutant Discharge Elimination System Permits for New York City's 14 Publicly Owned Treatment Works, August 24, 1995, regarding the costs and benefits of proposed pollution control investments.

"The Cost of Flow Control." Prepared for Browning-Ferris Industries, May 3, 1995.

"Economic Impacts of VOC Emission Reductions Beyond the 15% Plan in the Cincinnati CMSA." Prepared for Cincinnati Gas & Electric, April 27, 1995.

Prefiled Rebuttal Testimony before the Montana Public Service Commission, on behalf of the Montana Power Company, Docket No. 94.8.30, regarding affiliated coal prices, January 13, 1995.

Prefiled Direct Testimony before the Montana Public Service Commission, on behalf of the Montana Power Company, Docket No. 94.8.30, regarding affiliated coal prices, August 22, 1994.

"Water Quality Benefits of Floatable Reduction in the New York Bight." Expert Witness Report and Testimony on behalf of the New York City Law Department before the State of New York Department of Environmental Conservation in the Matter of the Application of The New York City Department of Environmental Protection for Renewals for the State Pollutant Discharge Elimination System (SPDES) Permits for New York City's 14 Publicly Owned Sewage Treatment Works. DEC No. 0026131, April 27, 1994.

Testimony before the United States District Court, District of Montana, on behalf of the Crow Tribe of Indians and the United States in *Crow Tribe of Indians and the United States v. State of Montana, et al.*, CV-78-110 BLG-JDS, regarding unjust enrichment and damages claims made by the Crow Tribe against the State of Montana, March 31, 1994.

Testimony before the United States District Court, District of Arizona, on behalf of the Navajo Nation in *Peabody Coal Company v. The Navajo Nation*, regarding the Navajo/Hopi coal tax dispute, March 17, 1994.

"Comments Regarding Water Pricing and Water Markets Under the Reclamation Reform Act of 1982," to the U.S. Bureau of Reclamation on behalf of the Natural Resources Defense Council, March 14, 1994.

"Initial Comments of National Economic Research Associates, Inc. on Florida DSM Employment Impacts," prepared with J. Landon and P. Griffes for Florida Power & Light Company, January 1994.

Rebuttal testimony before the Montana Public Service Commission on behalf of the Montana Power Company, Docket No. 93.6.24, regarding affiliated coal prices, October 15, 1993.

Declaration on behalf of the Hacienda Improvement Association before the Superior Court of the State of California, Case No. BS 021186, *Hacienda La Puente Unified School District of Los Angeles County, et al. v. County of Sanitation District No. 2 of Los Angeles County, et al.*, regarding solid waste disposal capacity in Los Angeles, October 14, 1993.

“A Review of Environmental Damage Studies.” Prepared for Ontario Hydro, October 1993.

Direct prefiled testimony before the Montana Public Service Commission on behalf of the Montana Power Company, Docket No. 93.6.24, regarding affiliated coal prices, June 21, 1993.

“Environmental Externalities Briefing Book.” Prepared for Florida Power & Light Company, April 17, 1993.

“External Costs of Electric Utility Resource Selection in Nevada.” Prepared with D. Harrison, Jr., A. Nichols, and S. Bittenbender for Nevada Power Company, March 1993.

Affidavit for Marathon Oil Company and the Shoshone and Northern Arapaho Tribes of the Wind River Indian Reservation in *Marathon Oil Company, Shoshone and Northern Arapaho Tribes of the Wind River Reservation v. State of Wyoming, et al.*, demonstrating how state and local taxes infringe on the Tribes’ abilities to manage their own energy resources and to provide necessary government services on the Reservation, November 19, 1992.

“The Economic Impacts of AOX Reduction on the U.S. Pulp and Paper Industry.” Sponsored by Georgia-Pacific Corporation, October 22, 1992.

Testimony before the Select Committee on Indian Affairs, United States Senate, on behalf of the Crow Indian Tribe regarding coal reserve appraisal, July 23, 1992.

“Appraisal of the 107th Meridian Strip Coal Reserves.” Prepared for the Crow Indian Tribe, July 1992.

“Carbon Tax Impacts on Coal Production and Rail Shipments.” Prepared with J. Wile for Association of American Railroads, May 1992.

“Socio-Economic Impacts of Strategies to Comply with the Clean Air Act Amendments of 1990.” Prepared for The Cincinnati Gas & Electric Company Licensing and Environmental Affairs Department, May 1992.

“The Environmental and Social Costs Associated with Wood Roof Removal Legislation.” Prepared with Clayton Environmental Consultants for Steel Roofing Manufacturers’ Association, February 1992.

“The Economic Feasibility of VOC Control Technologies for the Wood Furniture and Cabinet Industries.” Prepared for the American Furniture Manufacturers Association, Business and Institutional Furniture Manufacturers Association, Kitchen Cabinet Manufacturers Association, National Paint and Coatings Association, January 1992.

Rebuttal testimony before the Texas Public Utility Commission on behalf of Houston Lighting and Power, Docket No. 10473, regarding the treatment of environmental externalities, October 4, 1991.

“Key Issues in Least-Cost Planning.” With K. Anderson, National Economic Research Associates, Inc. Working Paper #10, August 1991.

“Hydroelectric Relicensing: Comparing the Value of Power and Nonpower Uses.” With M. Rosenzweig, April 1, 1991.

Expert testimony before the District Court of the Fifth Judicial District of the State of Idaho, *State of Idaho, ex rel. R. Keith Higginson v. United States, State of Idaho, et al.*, Case No. 39576, on behalf of the United States, regarding water claims fees, February 4, 1991.

“An Evaluation of State Efforts to Incorporate Environmental Externalities Into Electric Utility Planning.” Prepared for Central Maine Power and the Energy Research Group, with J. Wile, January 1991.

Testimony before the Oregon Environmental Quality Commission, on behalf of the Oregon Department of Environmental Quality, regarding out-of-state waste charges, November 1, 1990.

“Evaluation of Out-of-State Waste Surcharge Proposal.” Prepared for Oregon Department of Environmental Quality, October 5, 1990.

“Environmental Regulation Beyond the Clean Air Act Amendments: Incorporating Externalities,” Prepared with John Wile for the Energy Research Group, June 26, 1990.

“Economic Impacts of Proposed SO₂ Emissions Standards on Hamilton County, Ohio.” Prepared for the Hamilton County SO₂ Task Force, June 1990.

Testimony before Select Committee on Indian Affairs, United States Senate, “State Taxation and Indian Economic Development,” May 1, 1990.

Expert testimony before the Indiana Utility Regulatory Commission on behalf of Northern Indiana Public Service Company regarding acid rain legislation and coal price forecasts, September 27, 1989.

“Electric Utilities and the Environment in the 1990s.” Prepared with Lewis Perl for the Energy Research Group, June 20, 1989.

“The Impact of Environmental Regulation on Electric Utility Fuel Use.” *NERA Energy Outlook*, Special Report, April 17, 1989.

Affidavit for the New York City Department of Sanitation in *The Presidents’ Council of Trade Waste Associations, Inc., et al. v. Edward I. Koch, Mayor of the City of New York, et al.*, commenting on increases in waste disposal rates and methods used to determine rates, October 27, 1988.

Testimony on behalf of the Inter-Industry Wood Dust Coordinating Committee, before the Occupational Safety and Health Administration, Department of Labor, Docket No. H-020, August 12, 1988.

“The Economic Impact of OSHA’s Proposed Air Contaminants Rule on the Wood Products Industries.” Prepared for the Inter-Industry Wood Dust Coordinating Committee, July 25, 1988.

“Preliminary Estimate of Revenues Derived by Wyoming and Fremont County from Residents and Businesses on the Wind River Reservation and Expenditures by Wyoming and Fremont County for Services to the Reservation.” Prepared for the Shoshone and Arapaho Tribes, June 3, 1988.

“Determination of Market Price for Angel Mining Inc.’s and Diversified Fuels Inc.’s Contracts With Taiwan Power Company.” With F. Dunbar and J. Hausman before the International Chamber of Commerce on behalf of Angel/Diversified, April 1987.

“Economic Review of The McKinley County Coal Exchange.” With F. Dunbar, Washington, D.C.: National Coal Association, February 1987.

“Lessons For the Interstate Gas Pipeline Industry From Railroad Deregulation.” With F. Dunbar, Washington, D.C.: The Interstate Natural Gas Association of America, 1986.

Testimony before the Vermont Public Service Board on capacity planning and load forecasting on behalf of Central Vermont Public Service Corporation, July 12, 1985.

“The Economics of U.K. Coal Mining.” With S. Barrett, December 1984.

“Pricing Solid Waste Disposal in New York City,” November 1984.

“Risk Analysis of the Pacific Power and Light Company PCB Handling and Disposal Program.” With B. Price, October 19, 1984.

“An Evaluation of Capacity Planning and Load Forecasting for Central Maine Power Company.” With L. Perl and J. Wile, February 17, 1984.

Expert Witness Report and Testimony before the United States District Court, District of Montana, on the coal severance taxes and the market for Western coal, on behalf of the Crow Indian Tribe, 1984.

Co-author, “Solar Energy Technologies: Market Estimates and Federal R & D Payoff.” Prepared for the Energy Research Advisory Board, sponsored by the U.S. Department of Energy, 1982.

Co-author, “Analysis of Proposed Changes to Federal Surface Mining and Coal Leasing Policy.” Final Report for the U.S. Department of Energy, October 1982.

Co-author, “Barriers and Incentives for Fuel Cell Commercialization.” Prepared for the U.S. Department of Energy, 1981.

Antitrust, Business Damages, and Intellectual Property

Deposition testimony in the matter of Rincon San Luiseño Band of Mission Indians; and HCAL Corporation, a Nevada Corporation, vs. Dan McAllister, in his official capacity as Treasurer-Tax Collector of San Diego County, on behalf of the Rincon Tribe. May 26, 2005

Supplemental Expert Report in the matter of Rincon San Luiseño Band of Mission Indians; and HCAL Corporation, a Nevada Corporation, vs. Dan McAllister, in his official capacity as Treasurer-Tax Collector of San Diego County, on behalf of the Rincon Tribe. May 23, 2005

Expert Report of Mark Berkman, PhD, “Economic Impact of the Harrah’s Rincon Casino on San Diego County, California,” in the matter of *Rincon San Luiseño Band of Mission Indians; and HCAL Corporation, a Nevada Corporation, vs. Dan McAllister, in his official capacity as Treasurer-Tax Collector of San Diego County*, on behalf of the Rincon Tribe. March 21, 2005.

Expert Report of Mark P. Berkman in the matter of *Monster Cable Products, Inc. v. Discovery Communications, Inc.* before the United States District Court for the Northern District of California—San Francisco. July 23, 2004. Rebuttal Report filed August 13, 2004. Deposition Testimony taken in San Francisco on August 18, 2004.

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“Electric Utility Restructuring and Electricity Demand: Implications for the Nuclear Industry,” The Fuel Cycle 95 Conference, San Diego, California, April 3, 1995, sponsored by the Nuclear Energy Institute.

Discussant, Seventh Annual Western Conference/Advanced Workshop in Regulation and Public Utility Economics sponsored by the Rutgers Graduate School of Management Center for Research in Regulated Industries, San Diego, California, July 8, 1994.

Guest lecturer, “Applied Economics of Solid Waste,” course at University of California at Berkeley, March 19, 1994.

“Solid Waste Disposal Pricing: The Role of Social Costs,” 11th Annual Recycling Congress, National Recycling Coalition, Nashville, Tennessee, October 14, 1993.

“Incorporating Environmental Adders into Utility Resource Planning: A Status Report,” Electric Utility Business Environment Conference, Denver, March 17, 1993.

Panel member, “Solid Waste: Refuse or Resource” Conference, sponsored by the Global Cities Project, San Francisco, October 23, 1992.

“Incorporating Environmental Externalities into Utility Resource Planning,” Electric Utility and the Environment Conference, Chicago, September 24, 1992.

“Incorporating Environmental Externalities into Utility Planning,” Western Economic Association International Conference, July 12, 1992.

“Solid Waste Economics: Theory and Practice,” University of California at Berkeley, February 12, 1992.

“Economic Impacts of VOC Emissions Control on the Furniture and Cabinet Industries,” presented to the National Air Pollution Control Techniques Advisory Committee, Durham, North Carolina, November 21, 1991.

“Substituting Economics for Politics: Towards a Rational Water Allocation System,” San Francisco City Club, June 4, 1991.

“Pricing Solid Waste and Recycling,” seminar entitled The End of the Garbage Era: The Growth of Recycling in a Time of Fiscal Frugality, sponsored by The Northern California Recycling Association, Oakland, California, May 8, 1991.

“Recycling and Solid Waste Management: Market vs. Regulatory Approaches,” Fresh Thinking on Urban Issues: A Market Oriented Approach, Conference sponsored by The Reason Foundation, Los Angeles, California, September 17-18, 1990.

“The Economics of Waste or The Waste of Economics,” Trash 2000 Conference, sponsored by Claremont College Rose Institute of State and Local Government, Claremont, California, April 4, 1990.

“Generating Capacity Shortages and the Consequences for Economic Development,” 1990 Electric Utility Business Environment Conference, Denver, Colorado, March 8, 1990.

Panel member, “Natural Gas and the Environment” Conference, sponsored by Gas Daily, Washington, D.C., January 18, 1990.

“Estimating Natural Resource Damages Following *State of Ohio v. United States Department of Interior*,” presented at NERA Environmental Seminar Luncheon, San Francisco, California, January 16, 1990.

“Pricing Solid Waste Disposal at Marginal Cost: The New York City Experience,” presented to the Fifth International Conference on Solid Waste and Secondary Materials, Philadelphia, Pennsylvania, December 7, 1989.

“The Economic Impacts of Wood Dust Regulations,” presented to the Health Issues in the Forest Products Industry: Their Identification and Control Conference, Kissimee, Florida, October 31, 1989.

“Air Quality Regulations and Electricity Demand,” presented to the Energy and the Environment Conference, Denver, Colorado, September 12, 1989.

“The Economic Impact of Tribal Taxation,” presented to the Symposium on Tribal Taxation Within Indian Country, Sundance, Utah, November 10, 1988.

“The Underpricing of Landfills,” New York, NY: Third Annual Conference on Solid Waste Management and Materials Policy, February 1987.

“Conservation and Cogeneration: The Utilities’ Friends or Foes,” presented at the NERA Electric Utility Conference, Surviving an Era of Changing Regulation, February 1986.

ANTITRUST CASES

Investigation of the Proposed Merger of Waste Management, Inc. with USA Waste before the U.S. Department of Justice as required by the Hart Scott Rodino Act, 1998.

Strobe Data, Inc. v. Digital Equipment Corporation, before the United States District Court, Western District of Washington, C96-947C, 1997.

Investigation of the Proposed Acquisition of United Waste by USA Waste, before the U.S. Department of Justice as required by the Hart Scott Rodino Act, 1997.

Jerry Duke v. Browning Ferris Industries of Tennessee and Browning Ferris Industries, Tennessee Circuit Court, 1996.

Novadyne Computer Systems, Inc. v. Tandem Computers, Inc., before the United States District Court, Central District of California, No. 91-1941 THJ (KX), October, 1995.

Investigation of the Proposed Acquisition of Attwoods, Inc. by Browning-Ferris Industries, Inc. before the U.S. Justice Department as required by the Hart Scott Rodino Act, 1994.

Metals Recycling, Inc. v. American Waste Services, Inc., and Enviroco Transportation Management, Inc., before the U.S. District Court, District of Rhode Island, No. 91-0149B, 1992.

Hawaii Press v. Wolf Publishing et al., before the Circuit Court of the First Circuit, State of Hawaii, No. 88-1836-06, 1991.

High Technology Careers, a California partnership v. San Jose Mercury News, a California Corporation, before the U.S. District Court, Northern District of California, San Jose Division, No. 90-20579-SW, 1991.

BPHC Acquisition Inc. v. Penthouse International, Donald J. Trump, et al. before the Superior Court of New Jersey, 1990.

Zapata Gulf Marine Corporation v. Puerto Rico Maritime Shipping Authority, et al. before the U.S. District Court of the Eastern District of Louisiana, 1990.

ETSI Pipeline Project v. Burlington Northern Inc., et al., in the United States District Court for the Eastern District of Texas, Beaumont Division, No. B-84-979-CA, 1989.

Landmarks Holding Corporation, et al. v. David W. Bermant, et al., before the United States District Court, District of Connecticut, 1984.

Jefferson Disposal v. Parish of Jefferson, et al., before the United States District Court, for the Eastern District of Louisiana, 1984.

Scenic Trails, Inc. v. Greyhound Lines, Inc., et al., before the United States District Court, Western District of Wisconsin, 1984.

DAVID L. SUNDING

Senior Consultant

Ph.D. Agricultural and
Resource Economics,
University of California
at Berkeley

B.A. Economics, Claremont
McKenna College

CURRENT POSITIONS

2003–Present *Professor and Specialist*, Department of Agricultural and Resource Economics, University of California at Berkeley.

2003–Present *Senior Consultant*, CRA International, Boston, MA.

PAST POSITIONS

1997–2003 *Associate Professor and Specialist*, Department of Agricultural and Resource Economics, University of California at Berkeley.

1996–1997 *Senior Economist*, White House Council of Economic Advisers Executive Office of the President.

1992–1996 *Visiting Assistant Professor*, Department of Agricultural and Resource Economics, University of California at Berkeley.

1991–1992 *Senior Economist*, Law & Economics Consulting Group, Emeryville, CA.

1989–1992 *Assistant Professor*, Department of Economics and School of Law, Boston College.

COURSES TAUGHT

- Economics of Public Law (Boalt Hall School of Law)
- Natural Resource Economics
- Environmental Policy
- Industrial Organization of Food and Resource Markets
- Agricultural Policy (Graduate)

- Public Finance (Graduate)
- Microeconomic Theory (Graduate and Undergraduate)
- Law and Economics (Undergraduate and Law School)

UNIVERSITY SERVICE

- Member, CNR Committee on Directions, Opportunities and Initiatives, 2003.
- Member, CNR Executive Committee, 2003–2005.
- Member, Giannini Hall Seismic Retrofit Design Committee, 2003.
- Co-Director, Center for Sustainable Resource Development, College of Natural Resources, UC Berkeley, 1997–2003.
- Member, CNR Dean Search Committee, 2001–2002.
- Chair, Specialist Search Committee, Department of Agricultural and Resource Economics, 2001–2002.
- Member, CNR Advisory Board Development Committee, 2001–2002.
- Member, Faculty Search Committee (International Trade), Department of Agricultural and Resource Economics, 1999–2000.
- Member, CNR Dean Search Committee, 1999–2000.
- Member, Workgroup Review Committee, University of California Division of Agriculture and Natural Resources, 1999–2002.
- UC Berkeley Representative, Academic Assembly Council, University of California Division of Agriculture and Natural Resources, 1999–2001.
- Departmental Affirmative Action Representative, 1999–2000.
- Member, Faculty Search Committee (Environmental Health), Department of Agricultural and Resource Economics, 1998–2000.

PROFESSIONAL SERVICE

- Science Advisory Board, National Center for Housing and the Environment. 2003–Present.
- President, International Water Resource Economics Consortium, 2002–2004.
- Member, Expert Panel on Cost Allocation, CalFed Bay-Delta Program, 2001–2002.

- Member, National Academy of Sciences Panel on Water Conservation and Reuse, 2001–2002.
- Member, Technical Advisory Committee on Water Use Efficiency, CalFed Bay-Delta Program, 1997–1998.
- Referee: *Agricultural Economics*, *American Journal of Agricultural Economics*, *California Agriculture*, *Contemporary Economic Policy*, *Environmental and Resource Economics*, *Journal of Agricultural and Resource Economics*, *Journal of Business and Economic Strategy*, *Journal of Environmental Economics and Management*, *Journal of Political Economy*, *Journal of Public Economics*, *Land Economics*, *Natural Resources Modeling*, *Resource and Energy Economics*, *Review of Economics and Statistics*, *Social Choice and Welfare*, *Water Resources Research*.

RESEARCH AWARDS

U.S. Environmental Protection Agency. STAR Grant. “Mechanisms for Risk Trading.” \$206,000. 2002–2003.

Food Systems Research Group. “Optimal Commodity Promotion in Markets with Imperfect Competition and Differentiated Products.” \$40,000. 2002–2003.

Outstanding Journal Article Award, AAEA, 2001.

Giannini Foundation of Agricultural Economics. “Economic Benefits of Joint Management of Surface and Ground Water Storage Facilities.” \$17,000. 2001–2002.

Best Published Research Award Finalist, WAEA, 1998.

California Department of Food and Agriculture. “Economic Impacts of Pesticide Regulation.” \$1,150,000. 1994–2002.

California Department of Water Resources and U.S. Department of the Interior (CALFED Program). “Economic Valuation of Increased Water Supply Reliability and Trading Opportunities by Westside Agriculture.” \$80,000. 1998–2000.

California Department of Food and Agriculture. “Economic Importance of Compound 1080 in California Agriculture.” \$60,000. 1998–1999.

U.S. Department of Interior, Bureau of Reclamation. “Financial Incentives to Encourage Agricultural Water Conservation.” \$749,000. 1994–2000.

U.S. Environmental Protection Agency. “Economic Incentives to Reduce Nonpoint Source Loads in Nevada’s Truckee River Basin.” \$98,500. 1995–1997.

PUBLICATIONS

Published Papers

“Wetlands Regulation in Flux...An Opening for Meaningful Reform?” *Regulation* (2003): in press.

“Factor Price Risk and the Adoption of Conservation Technology.” With Georgina Moreno. *Frontiers in Water Resource Economics*. D. Berga and R. Goetz, eds. Kluwer, in press.

“Optimal Management of Groundwater over Space and Time.” With Nicholas Brozovic and David Zilberman. *Frontiers in Water Resource Economics*. D. Berga and R. Goetz, eds. Kluwer, in press.

“Government Regulation of Product Quality in Markets with Differentiated Products: Looking to Economic Theory.” *American Journal of Agricultural Economics* (2003): in press.

“Environmental Regulation by Licensing: Observations on Recent Changes to the Federal Wetland Permitting Program.” With David Zilberman. *Natural Resources Journal* 42(Winter 2002): 59-90.

“Trading Patterns in an Agricultural Water Market.” With Nicholas Brozovic and Janis Carey. *Water Resources Update* (2002): 3-16.

“Public Goods and the Value of Product Quality Regulations: The Case of Food Safety.” With Stephen Hamilton and David Zilberman. *Journal of Public Economics* 87 (2003): 799-817.

“Voluntary Development Restrictions and the Cost of Habitat Preservation.” With Sabrina Lovell. *Real Estate Economics* 29 (March 2001): 191–206.

“Regulating Pollution with Endogenous Monitoring.” With Katrin Millock and David Zilberman. *Journal of Environmental Economics and Management* (2002): 221-241.

“Emerging Markets in Water: A Comparative Institutional Analysis of the Central Valley and Colorado-Big Thompson Projects.” With Janis Carey. *Natural Resources Journal* 41 (2001): 283–328.

“Insect Population Dynamics, Pesticide Use and Farmworker Health.” With Joshua Zivin. *American Journal of Agricultural Economics* 82 (August 2000): 527–540.

“Transactions Costs and Trading Behavior in an Immature Water Market.” With Janis Carey and David Zilberman. *Environment and Development Economics* (2002): in press.

“Agricultural Risk Management and the Environment.” With Mark Metcalfe and David Zilberman. In R. Just and R. Pope (eds.). *A Comprehensive Assessment of the Role of Risk in U.S. Agriculture*. New York: Kluwer, 2001.

“A Comparison of Policies to Reduce Pesticide Poisoning Combining Economic and Toxicological Data.” With Joshua Zivin. In: Joe Moffitt (ed.). *Advances in the Economics of Environmental Resources: Volume 4*. Greenwich: JAI Press, 2001.

“The Impact of Climate Change on Agriculture: A Global Perspective.” With David Zilberman and Xuemei Liu. In: Charles Moss, Gordon Rausser, Andrew Schmitz, Tim Taylor and David Zilberman (eds.), *Agricultural Globalization, Trade, and the Environment*. New York: Kluwer, 2001.

“The Agricultural Innovation Process: Research and Technology Adoption in a Changing Agricultural Sector.” With David Zilberman. In: Bruce Gardner and Gordon Rausser (eds.), *Handbook of Agricultural and Resource Economics*. Amsterdam: North Holland, 2001.

“Product Liability, Entry Incentives and Market Structure.” With Stephen Hamilton. *International Review of Law and Economics* 20 (September 2000): 269–283.

“Measuring the Costs of Reallocating Water from Agriculture: A Multi-Model Approach.” With David Zilberman, Richard Howitt, Ariel Dinar, and Neal MacDougall. *Natural Resources Modeling* (Summer 2002): 201–224.

“Climate Change Policy and the Agricultural Sector.” With David Zilberman. In: R. Lal, J.M. Kimble, R.F. Follett and B.A. Stewart (eds.), *Assessment Methods for Soil Carbon*. New York: CRC Press, 2000, 629–643.

“Methyl Iodide as an Alternative to Methyl Bromide.” With Brent Hueth, Bruce McWilliams and David Zilberman. *Review of Agricultural Economics* (Spring/Summer 2000): 43–54.

“Using Water Markets to Improve Environmental Quality: Two Innovative Programs in Nevada.” With Sabrina Ise Lovell and Katrin Millock. *Journal of Soil and Water Conservation* 55 (First Quarter 2000): 19–26.

“The Price of Water...Market-Based Strategies are Needed to Cope with Scarcity.” *California Agriculture* 54 (March-April 2000): 56–63.

“Designing Environmental Regulations with Empirical Microparameter Distributions: The Case of Seawater Intrusion.” With Gareth Green. *Resource and Energy Economics* 22 (January 2000): 63–78.

“The Economics of Inter-District Water Transfers in California.” In *Proceedings of the American Society of Civil Engineers*. New York: ASCE, 1999.

“Returns to Public Investment in Agriculture with Imperfect Downstream Competition.” With Stephen Hamilton. *American Journal of Agricultural Economics* 80(November 1998): 830–838.

“Reallocating Water from Agriculture to the Environment under a Voluntary Purchase Program.” With Sabrina Ise. *Review of Agricultural Economics* 20(Summer 1998): 214–226.

An Environmentally Optimal Alternative for the San Francisco Bay-Delta. With John Cain, David Fullerton, David Purkey and Greg Thomas. San Francisco: Natural Heritage Institute, 1998.

“Allocating Product Liability in a Multimarket Setting.” With David Zilberman. *International Review of Law and Economics* 18(March 1998): 1–11.

“Resolving Trans-Boundary Water Disputes: Economists’ Influence on Policy Choices in the United States.” In: Richard Just and Sinaia Netanyahu (eds.), *Conflict and Cooperation on Trans-Boundary Water Resources*. Norwell: Kluwer, 1998.

“Economics and Pesticide Regulation.” With Erik Lichtenberg, Douglas Parker and David Zilberman. *Choices* (Fourth Quarter 1997): 26–29.

“The Effect of Farm Supply Shifts on Concentration and Market Power in the Food Processing Sector.” With Stephen Hamilton. *American Journal of Agricultural Economics* 79 (May 1997): 524–531.

“Land Allocation, Soil Quality and the Demand for Irrigation Technology.” With Gareth Green. *Journal of Agricultural and Resource Economics* 22 (November 1997): 367–375.

“Water Marketing in the ’90s: Entering the Electronic Age.” With Janis Carey, David Zilberman and Douglas Parker. *Choices* (Third Quarter 1997): 15–19.

“Modeling the Impacts of Reducing Agricultural Water Supplies: Lessons from California’s Bay/Delta Problem.” With David Zilberman, Neal MacDougall, Richard

Howitt and Ariel Dinar. In: Doug Parker and Yacov Tsur (eds.), *Decentralization and Coordination of Water Resource Management*. New York: Kluwer, 1997.

“The Changing Nature of Agricultural Markets: Implications for Privatization of Technology, Information Transfer and Land Grant Research and Extension.” With David Zilberman and Madhu Khanna. In: Stephen Wolf (ed.), *Privatization of Information and Agricultural Industrialization*. Boca Raton: CRC Press, 1997.

“Changes in Irrigation Technology and the Impact of Reducing Agricultural Water Supplies.” With Ariel Dinar and David Zilberman. In: Darwin Hall (ed.), *Advances in the Economics of Environmental Resources: Volume 1*. Greenwich: JAI Press, 1996.

“Measuring the Marginal Cost of Nonuniform Environmental Regulations.” *American Journal of Agricultural Economics* 78 (November 1996): 1098–1107.

“Explaining Irrigation Technology Choices: A Microparameter Approach.” With Gareth Green, David Zilberman and Douglas Parker. *American Journal of Agricultural Economics* 78 (November 1996): 1064–1072.

“How Does Water Price Affect Irrigation Technology Adoption?” With Gareth Green, David Zilberman, Douglas Parker, Cliff Trotter and Steve Collup. *California Agriculture* 50 (March-April 1996): 36–40.

“Strategic Participation and the Median Voter Result.” *Economic Design* 1 (April 1996): 355–363.

“Social Choice by Majority Rule with Rational Participation.” *Social Choice and Welfare* 12 (December 1995): 3–12.

“Water Markets and the Cost of Improving Water Quality in the San Francisco Bay/Delta Estuary.” With David Zilberman and Neal MacDougall. *West-Northwest Journal of Environmental Law and Policy* 2 (Spring 1995): 159–165.

“Flexible Technology and the Cost of Improving Groundwater Quality.” With David Zilberman, Gordon Rausser and Alan Marco. *Natural Resource Modeling* 9 (April 1995): 177–192.

“Water for California Agriculture: Lessons from the Drought and New Water Market Reform.” With David Zilberman, Richard Howitt, Ariel Dinar and Neal MacDougall. *Choices* (Fourth Quarter 1994): 25–28.

“Methyl Bromide Regulation...All Crops Should Not Be Treated Equally.” With Cherisa Yarkin, David Zilberman, and Jerry Siebert. *California Agriculture* 48 (May-June 1994): 10–15.

“Cancelling Methyl Bromide for Postharvest Use to Trigger Mixed Economic Results.” With Cherisa Yarkin, David Zilberman and Jerry Siebert. *California Agriculture* 48 (May-June 1994): 16–21.

“Who Makes Pesticide Use Decisions? Implications for Policymakers.” With David Zilberman, Michael Dobler, Mark Campbell and Andrew Manale. In: Walter Armbruster (ed.), *Pesticide Use and Product Quality*. Glenbrook: Farm Foundation, 1994.

“Managing Groundwater Quality under Uncertainty.” With David Zilberman and Gordon Rausser. In: Michelle Marra (ed.), *Quantifying Long-Run Agricultural Risks*. Orono: University of Maine, 1993.

“Natural Resource Cartels.” With David Teece and Elaine Mosakowski. In: Allen Kneese and James Sweeney (eds.), *Handbook of Natural Resource and Energy Economics, Volume III*. Amsterdam: Elsevier, 1993.

“Joan Robinson as a Development Economist.” With Irma Adelman. In: George Feiwel (ed.), *Joan Robinson and Modern Economic Theory*. London: Basil Blackwell, 1988.

“Economic Policy and Income Distribution in China.” With Irma Adelman. *Journal of Comparative Economics* 11(September 1987): 444–461. Reprinted in Bruce Reynolds (ed.), *China's Economic Development: How Far, How Fast?* New York: Academic Press, 1989. Reprinted in Joseph C. H. Chai (ed.), *The Economic Development of Modern China*. London: Edward Elgar, 1999.

Works under Review

“Generational Transition and Technology Choice.” With Gareth Green and David Zilberman. Revision requested by *Economic Development and Cultural Change*.

“Estimation of Agricultural Water Demand.” With Karina Schoengold and Georgina Moreno.

“Prices Vs. Quantities Revisited.” With Nicholas Brozovic and David Zilberman.

“The Value of Public Investment in Water Supply Reliability.” With Georgina Moreno, Daniel Osgood and David Zilberman.

“The Impact of Climate Change on Agriculture: A Conceptual Study.” With Xuemei Liu and David Zilberman.

“Simultaneous Estimation of Technology Choice and Land Allocation.” With Georgina Moreno.

“Optimal Extraction of Groundwater when User Cost Varies over Space and Time.” With Nicholas Brozovic and David Zilberman.

“Competitive and Optimal Groundwater Extraction with a Finite Aquifer.” With Nicholas Brozovic and David Zilberman.

Technical Reports and Monographs

Economic Impacts of Critical Habitat Designation for the Coastal California Gnatcatcher. June 2003.

The Economic Impacts of Critical Habitat Designation: Framework and Application to the Case of California Vernal Pools. With Aaron Swoboda and David Zilberman. January 2003.

Non-Federal and Non-Regulatory Approaches to Wetland Conservation: A Post-SWANCC Evaluation of Conservation Alternatives. December 2002.

Economic Impacts of Earthquake-Induced Water Supply Shortages in the San Francisco Bay Area. With Nicholas Brozovic and David Zilberman. October 2002.

Economic Impacts of Organophosphate Use in California Agriculture, Parts 1 and 2. With Mark Metcalfe, Bruce McWilliams, Brent Hueth, Robert Van Steenwyk and David Zilberman. February 2002.

Water Pricing and Water Use Efficiency. January 2001.

Economic Impacts of Critical Habitat Designation for the California Red-Legged Frog. With David Zilberman. January 2001.

A Proposal for Management of the Confined Aquifer in the Western San Joaquin Valley. With David Purkey. July 2000.

Analysis of the Army Corps of Engineers’ NWP 26 Replacement Permit Proposal. With David Zilberman. February 2000.

Economic Valuation of Increased Water Supply Reliability and Trading Opportunities in Westside Agriculture. With Georgina Moreno, Daniel Osgood and David Zilberman. December 1999.

Costs of Implementing the Food Quality Protection Act of 1996 on California Agriculture. With Bruce McWilliams, Yuria Tanimichi and David Zilberman. September 1999.

Economic Impact of Restricting Use of Compound 1080 in California's Intermountain Region. With Brent Hueth and Michelle McGregor. April 1999.

Downstream Economic Impacts of Reducing Federal Water Subsidies: The Case of Alfalfa and Dairy. With Gergina Moreno. August 1998.

Economic Importance of Organophosphates in California Agriculture. With Brent Hueth, Grazyna Michalska, and David Zilberman. August 1998.

Water Trading and Environmental Quality in the Western United States. With David Zilberman. April 1998.

Impact of Endangered Species Legislation on California Agriculture. With David Zilberman, Jerome B. Siebert, Joshua Zivin, Sabrina Isé and Brent Hueth. January 1998.

Economics Impacts on California Agriculture of Banning Methyl Bromide Use. With Bruce McWilliams, Brent Hueth, Lori Lynch, David Zilberman and Jerome Siebert. January 1998.

Economic Incentives for Improving Water Quality in Nevada's Truckee River Basin. With Sabrina Ise and Katrin Millock. October 1996.

Managing Seawater Intrusion in Monterey County through Agricultural Water Conservation. With Gareth Green and Larry Dale. May 1995.

Conclusions and Recommendations on a Framework for Comparative Cost Effectiveness Assessment of CVP Yield Augmentation Alternatives. With Greg Thomas. December 1994.

Economic Impacts of USFWS' Water Rights Acquisition Program for Lahontan Valley Wetlands. June 1994.

Market Implementation of Bay/Delta Water Quality Standards. March 1994.

Economic Impacts of Mevinphos Cancellation in California. March 1994.

Economic Impacts of Federal Worker Protection Standards. With Cheryl Brown, Valerie Brown and Bob Chavez. October 1993.

Water Quality Regulation in the San Francisco Bay and Delta. With David Zilberman, Richard Howitt, Neal MacDougall and Linda Fernandez. May 1993.

The Economic Consequences of Enforcing the Delaney Clause. With Alan Marco. March 1993.

Economic Impacts of Cancelling Methyl Bromide in California. With Cherisa Yarkin, David Zilberman, Jerome Siebert and Alan Marco. February 1993.

Economic Impact of the Silverleaf Whitefly. With Jerome Siebert, David Zilberman and Michael Roberts. January 1993.

INVITED PRESENTATIONS

“Simultaneous Estimation of Technology Choice and Land Allocation.” With Georgina Moreno. American Agricultural Economics Association. Montreal, Canada. August 2003.

“Advertising in Markets with Product Differentiation and Imperfect Competition.” Food Systems Research Group, University of Wisconsin. June 2003.

“Wetlands Protection Beyond Section 404.” American Law Institute–American Bar Association. Washington, DC. May 2003.

“Prioritizing Habitat Conservation.” Conference on the Endangered Species Act. Land Use Research Foundation of Hawaii and the Hawaii State Bar Association Section on Real Property and Finance. May 2003.

“Government Regulation of Product Quality in Markets with Differentiated Products: Looking to Economic Theory.” Allied Social Science Association. Washington, DC. January 2003.

“Non-Regulatory and Non-Federal Approaches to Wetland Protection.” National Association of Home Builders. Las Vegas, NV. January 2003.

“Agricultural Water Use and the Role of Prices.” Joint Meeting of the U.S. and Iranian Academies of Sciences. Tunis, Tunisia. December 2002.

“Economic Megatrends and Water Use in the United States.” National Academy of Sciences. Washington, DC. September 2002.

“Pesticide Regulation and Changes in Human Health.” World Congress of Environmental Economics. Monterey, CA. June 2002.

“Mechanisms for Risk Trading.” World Congress of Environmental Economics. Monterey, CA. June 2002.

“Economic Damage from Water Supply Disruptions Following an Earthquake in the San Francisco Bay Area.” Bay Area Water Users’ Association. Foster City, CA. June 2002.

“Economic Perspectives on Federal Wetland Regulation.” American Law Institute–American Bar Association. Washington, DC. May 2002.

“Reconciling Competing Interests in the West Side.” CSRD Conference on the Future of the West Side. Parlier, CA. March 2002.

“Protecting Public Interests on Private Land.” Center for Sustainable Resource Development, UC Berkeley. February 2002.

“Cost-Shifting and Environmental Quality.” POWER Annual Conference. Los Angeles, CA. December 2001.

“Factor Price Risk and the Diffusion of Conservation Technology.” California Conference on Environmental and Resource Economics. UC Santa Barbara. November 2001.

“Valuation of Water Supply Reliability.” American Agricultural Economics Association. Chicago, IL. August 2001.

“Allocating Water by Markets.” American Society of Horticultural Sciences. Sacramento, CA. July 2001.

Core Faculty. Beahrs Environmental Leadership Program. Berkeley, CA. July 2001.

“The Farm Bill and Resource Conservation: Success Stories.” CSRD Conference on Agriculture and the Environment. Washington, DC. June 2001.

“Does Factor Price Risk Encourage Conservation?” International Water Resource Economics Consortium. Girona, Spain. June 2001.

“Optimal Control of Groundwater Over Space and Time.” International Water Resource Economics Consortium. Girona, Spain. June 2001.

“Trading Behavior in an Informal Market.” International Water Resource Economics Consortium. Girona, Spain. June 2001.

“Economics of Pesticide Cancellation: The Food Quality Protection Act of 1986.” University of California Agricultural Economics and Management Workgroup. UC Davis. May 2001.

“Economic Aspects of Biological Control.” University of California Conference on Urban Pest Management. UC Riverside. October 2000.

“Price Volatility and Resource Conservation.” American Agricultural Economics Association. Tampa, FL. July 2000.

“Economics of Water Trading in California.” UC Berkeley Water Working Group. Berkeley, CA. March 2000.

“Reforming Public Lands Policy.” Painting the White House Green: Economics and Environmental Policy-Making in the Clinton Administration. Laramie, WY. September 1999.

“Transaction Costs and Trading Behavior in a Permit Market.” American Agricultural Economics Association. Nashville, TN. August 1999.

“Facilitating Water Transfers with the *WaterLink* System.” American Society of Civil Engineers. Seattle, WA. August 1999.

“Valuing Agricultural Water Supply Reliability.” International Water Resource Economics Consortium. Waikoloa, HI. July 1999.

“Economics of Inter-District Water Transfers.” Western Economics Association. San Diego, CA. June 1999.

“The Value of Water Supply Reliability in Westside Agriculture.” CalFed Economics Workgroup. Sacramento, CA. June 1999.

“Economic Impacts of Pesticide Regulation.” Center for Sustainable Resource Development Conference on Pest Management. UC Berkeley. May 1999.

“Water Marketing within Irrigated Agriculture.” American Agricultural Economics Association. Salt Lake City, UT. August 1998.

“Welfare Impacts of Climate Change: Focus on Pest Problems and Water Resources.” American Agricultural Economics Association. Salt Lake City, UT. August 1998.

“Water Trading and the Costs of Bay/Delta Protection.” Water Education Foundation. San Diego, CA. July 1998.

“Federal Public Land Policy: Litmus Test Issues.” Berkeley Commons Club. Berkeley, CA. June 1998.

“Recent Developments in American Agricultural Policy.” Commonwealth Club. San Francisco, CA. October 1997.

“Performance of a Voluntary Water Purchase Program.” Western Regional Water Economics Conference. Lihue, HI. October 1997.

“Water Marketing for the Environment: The Clinton Administration’s Perspective.” Conference on Regional Water Markets. Berkeley, CA. July 1997.

“Returns to Public Investment in Agriculture with Imperfect Downstream Competition.” American Agricultural Economics Association. Toronto, Canada. July 1997.

“Markets for Crop Germplasm.” Invited Paper, American Agricultural Economics Association. Toronto, Canada. July 1997.

“Land Allocation, Soil Quality and Irrigation Technology Choice.” Western Agricultural Economics Association. Reno, NV. July 1997.

“Product Liability and Entry Incentives.” Western Agricultural Economics Association. Reno, NV. July 1997.

“Agricultural Policy in the Post-1996 Farm Act World.” Signature Lecture, USDA Economic Research Service. Washington, DC. May 1997.

“Federal Water Policy in the United States.” International Conference on Coordination and Decentralization in Water Resources Management. Annapolis, MD. April 1997.

“Non-Uniform Regulation of Groundwater Quality.” American Agricultural Economics Association. San Antonio, TX. July 1996.

“The Effect of Farm Supply Shifts on Concentration and Market Power in the Food Processing Industry.” American Agricultural Economics Association. San Antonio, TX. July 1996.

“Differential Property Tax Assessment, Land Allocation and Land Values at the Urban Fringe.” American Agricultural Economics Association. San Antonio, TX. July 1996.

“Efficient Strategies for Acquiring Agricultural Water Rights.” Invited Paper, Australian Agricultural and Resource Economics Society. Melbourne, Australia. February 1996.

“Strategies for Agricultural Water Conservation.” U.S. Bureau of Reclamation Water Users Conference. Concord, CA. January 1996.

“Voting on Environmental Health Risks.” American Agricultural Economics Association. Indianapolis, IN. August 1995.

“Explaining Irrigation Technology Choice: A Microparameter Approach.” American Agricultural Economics Association. Indianapolis, IN. August 1995.

“The Economics of United States Environmental Laws.” Symposium at Far Eastern State University. Vladivostok, Russia. March-April 1995.

“The Endangered Species Act: Impact on California Agriculture and Policy Options.” University of California Executive Seminar on Agricultural Issues. Sacramento, CA. December 1994.

“Economics of Tort Liability Rules for Pesticide Damage.” Second Occasional California Conference on Environmental and Resource Economics. Santa Barbara, CA. October 1994.

“Water Law as a Regulating Mechanism.” International Conference on Coordination and Decentralization in Water Resources Management. Rehovot, Israel. September 1994.

“Contaminant Dynamics and the Cost of Groundwater Quality Regulations.” Conference on Pesticide Economics and Policy in Memory of Carolyn Harper. Amherst, MA. April 1994.

“Water Markets and Water Quality.” University of California Conference on Regional Water Constraints. Berkeley, CA. October 1993.

“Irreversibility, Contaminant Dynamics and the Cost of Groundwater Quality Regulations.” American Agricultural Economics Association. Orlando, FL. August 1993.

“Methodological Issues in Pesticide Regulation.” First Occasional California Conference on Environmental and Resource Economics. Santa Barbara, CA. May 1993.

“Economic Impacts of the Central Valley Project Improvement Act.” First Occasional California Conference on Environmental and Resource Economics. Santa Barbara, CA. May 1993.

“Majority Rule with Rational Abstention is Globally Transitive.” Sixth World Congress of the Econometric Society. Barcelona, Spain. August 1990.

GOVERNMENT BRIEFINGS

“Non-Federal and Non-Regulatory Approaches to Wetland Conservation.” House Transportation and Infrastructure Committee Staff. Washington, DC. February 2003.

“Removing Barriers to Water Marketing.” California Senate Committee on Agriculture and Water and the California Foundation for Environment and Economy. Berkeley, CA. January 2003.

“Agricultural Water Pricing and Water Use Efficiency.” U.S. Bureau of Reclamation. Sacramento, CA. May 2002.

“Assessing Recent Changes to the Wetlands Permitting Process.” Congressional Real Estate Caucus. Washington, DC. September 2000.

“Water Markets in California.” California Assembly and Senate Staff. Sacramento, CA. May 2000.

“Economic Analysis of Proposed Changes in Wetlands Permitting Policies.” U.S. House of Representatives and Senate Staff. Washington, DC. March 2000.

“Groundwater Implications of Water Trading.” California Assembly Water Parks and Wildlife Committee and Senate Agriculture and Water Committee. Sacramento, CA. November 1999.

“Economic Aspects of the 1996 Food Quality Protection Act.” Office of Policy, U.S. Environmental Protection Agency. Washington, DC. October 1998.

“Innovative Approaches to Water Conservation: The Westside Case.” Joint U.S. Bureau of Reclamation and the California Department of Water Resources Water Conservation Information Committee. San Diego, CA. August 1998.

“Climate Variability and U.S. Agriculture: Mitigating the Impacts.” U.S. Environmental Protection Agency. Washington, DC. May 1998.

“New Approaches to Agricultural Water Conservation.” Congressional Water Caucus. Washington, DC. February 1996.

LEGISLATIVE AND ADMINISTRATIVE TESTIMONY

“Economic Impacts of Critical Habitat Designation.” Subcommittee on Fisheries, Wildlife and Water, Committee on Environment and Public Works, U.S. Senate, April 2003.

“Performance of the Federal Wetlands Permitting Program.” Subcommittee on Water and Wetlands, Committee on Transportation and Infrastructure, U.S. House of Representatives. September 2001.

“Economic Observations on Water Infrastructure Investment in California.” Subcommittee on Water and Power, Committee on Transportation and Infrastructure, U.S. House of Representatives. July 2001.

“Economic Impacts of Reduced Water Supplies on Westside Agriculture.” Bay-Delta Advisory Committee. June 1998.

“Economic Impacts of the Central Valley Project Improvement Act.” Subcommittee on Water and Power, Committee on Transportation and Infrastructure, U.S. House of Representatives. April 1998.

“Forest Service Losses on Below-Cost Timber Sales.” Committee on Energy and Natural Resources, U.S. Senate. February 1997.

“Benefits and Costs of Enhanced Flood Protection in the American River Valley.” Committee on Transportation and Infrastructure, U.S. House of Representatives. February 1996.

“Economic Impacts of Banning Methyl Bromide Use in California Agriculture.” Committee on Appropriations, California Senate. February 1996.

“Economic Impacts on Leeward Agriculture of Eliminating Waiahole Ditch Diversions.” Hawaii Water Commission. January 1996.

“Least-Cost Implementation of Bay/Delta Water Quality Standards.” California Water Resources Control Board. July 1994.

“The Potential for Agricultural Water Conservation.” California Water Resources Control Board. June 1992.

“Economic Impacts of the Central Valley Project Improvement Act.” Committee on Energy and Natural Resources, U.S. Senate. April 1992.

SEMINARS

University of Arizona, Boston College, Boston University, UC Berkeley, UC Davis, UC Riverside, UC Santa Barbara, University of Colorado, Harvard University, Hebrew University, Kansas State University, University of Maryland, University of Massachusetts, Montana State University, Purdue University, Stanford University, U.S.

Department of Agriculture, U.S. Department of the Interior, U.S. Environmental Protection Agency, University of Wyoming.

GRADUATE STUDENTS SUPERVISED

Prof. Nicholas Brozovic

Current Position: Assistant Professor, Department of Agricultural and Consumer Economics, University of Illinois.

Prof. Sean Cash

Current Position: Assistant Professor, Department of Agricultural and Resource Economics, University of Calgary.

Prof. Georgina Moreno

Current Position: Assistant Professor, Department of Economics, Scripps College.

Prof. Daniel Osgood

Current Position: Assistant Professor, Department of Agricultural and Resource Economics, University of Arizona.

Prof. Joshua Zivin

Current Position: Assistant Professor, Department of Public Health, Columbia University School of Medicine.

Prof. Janis Carey

Current Position: Assistant Professor, Colorado School of Mines.

DR.. Katrin Millock

Current Position: Chargée de recherché, Centre International de Recherche sur L'Environnement et le Développement (CIRED), CNRS, Paris.

Dr. Sabrina Ise

Current Position: Economist, National Center for Environmental Economics, U.S. Environmental Protection Agency, Washington, D.C.

Prof. Steven Hamilton

Current Position: Associate Professor, Department of Economics, University of Arizona.

Prof. Gareth Green

Current Position: Assistant Professor, Department of Economics, Washington State University.

SELECTED CONSULTING

- Aetna, Inc., New York, NY.
- American Petroleum Institute, Washington, DC.
- Bay Area Economic Forum, San Francisco, CA.
- Building Industry Association of Southern California, Diamond Bar, CA.
- California Resource Management Institute, Sacramento, CA.
- Dow Chemical, Inc., New York, NY.
- Enron Corporation, Houston, TX.
- Environmental Defense Fund, Oakland, CA.
- Fannie Mae, Washington, DC.
- Freddie Mac, Washington, DC.
- Home Builders Association of Northern California, San Leandro, CA.
- Hughes Aircraft, Inc., Los Angeles, CA.
- iAqua, Inc., Dallas, TX.
- Intel Corporation, Santa Clara, CA.
- Intercontinental Hotels, Inc., New York, NY.
- The Irvine Company, Irvine, CA.
- Metropolitan Water District, Los Angeles, CA.
- National Association of Counties, Washington, DC.
- National Association of Home Builders, Washington, DC.
- National Center for Housing and the Environment, Washington, DC.
- Natural Resources Defense Council, San Francisco, CA.
- The Nature Conservancy, Boulder, CO.
- Occidental Chemical, Inc., Los Angeles, CA.
- Prudential Insurance, Inc., New York, NY.
- San Diego County Water Authority, San Diego, CA.
- Shell Chemical, Inc., New York, NY.
- Shell Oil, Inc., New York, NY.
- Sierra Club Legal Defense Fund, Honolulu, HI.
- Suez/ONDEO, Paris.
- Teledyne, Inc., Los Angeles, CA.
- Toro, Inc., Minneapolis, MN.

PROFESSIONAL ASSOCIATIONS

American Agricultural Economics Association

American Association for the Advancement of Science

American Economic Association

American Law and Economics Association

Econometric Society

VIII. APPENDIX B. DOCUMENTS RELIED ON

Materials Relied Upon or Cited

Document Title	Date
[1] "Irrigation with Reclaimed Municipal Wastewater: A Guidance Manual," California State Water Resources Control Board, July 1984	July 1, 1984
[2] Miller, R. and P. Blair, <i>Input Output Analysis, Foundations and Extensions</i> , New Jersey: Prentice Hall, 1985	January 1, 1985
[3] Order No. 94-276, November 4, 1994.	November 4, 1994
[4] "Proposed Technology-Based Treatment Unit Processes and Revised Reclamation Management Plan," Nolte and Associates, November 30, 1994.	November 30, 1994
[5] "California Regional Water Quality Control Board, Central Valley Region: Order Number 97-206, Waste Discharge Requirements for Hilmar Cheese Company, Inc., Hilmar Whey, Inc., Hilmar Cheese Company Properties Partnership, Alvin A. and Devona Wickstrom, Kathy and Delton Nyman d.b.a. Delton Nyman's Farm, and Jose G. and Marie C. Silveira, Merced County," September 19, 1997.	September 19, 1997
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[8] Letter from Bert Van Voris to John Jeter regarding Report of Waste Discharge supplementing June 2, 2000, letter, August 2, 2000.	August 2, 2000
[9] "Draft: Hilmar Cheese Company, Meeting with Regional Board," August 22, 2000.	August 22, 2000
[10] (1) "1998-2001 Expansion of Hilmar Cheese (HCC)," written by Jay Hicks for Sanwa Bank on January 28, 1998; (2) "Hilmar Cheese Expansion Status, July 29, 1999," (3) "Expansion Update, 2-May-02".	May 2, 2002
[11] "Report of Waste Discharge for Hilmar Cheese Company, Hilmar, California, February 2001," prepared by Brown and Caldwell.	February 1, 2001
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